Chapter 4
Competitiveness

Chapter Contents

This chapter focuses on the performance and cost of each substitute blanket wash. Section 4.1 discusses the results of the performance demonstration of each blanket wash, both in a laboratory setting and in an actual print shop. All 37 blanket washes (including the baseline) were tested at the Graphic Arts Technical Foundation (GATF) laboratory for flash point, volatile organic compound (VOC) content, pH, blanket swell potential and wipability. Of the 36 formulations (plus the baseline) analyzed at GATF, 22 were field tested. Each of these 22 blanket washes was used at two print shops, and evaluated on factors such as how well the ink was cut and how quickly the blanket dried. The limitations of these field evaluations are briefly presented and the results discussed in greater detail. Section 4.2 presents the costs associated with using the 22 field tested blanket washes. For each of the two facilities where a blanket wash was tested, data on cost/wash, cost/press, and cost/press/shift/year were developed and compared with baseline costs using VM&P Naphtha. This section also contains a description of the different variables used to develop the cost data, such as labor costs, blanket wash costs, and other materials costs. Section 4.3 addresses international trade issues for blanket washes in general. Importation and exportation of both petroleum based blanket washes and low VOC blanket washes are discussed, as well as joint ventures between foreign companies.

4.1 PERFORMANCE DATA

4.1.1 Background

This section of the CTSA summarizes performance information collected during laboratory and production run performance demonstrations with substitute blanket washes carried out between November 1994 and January 1995. Performance data collected included information such as quantity of wash used, time spent to wash the blanket, ink coverage, and the effectiveness of the wash. Data from the performance demonstrations, in conjunction with risk, cost and other information presented in other sections of the CTSA, provides a more complete assessment of substitute blanket washes than has otherwise been available from one source.

In a joint and collaborative effort, EPA worked with the Printing Industries of America (PIA), the Graphic Arts Technical Foundation (GATF), and other industry representatives to organize and conduct the performance evaluations of 36 substitute blanket washes and the baseline. The

demonstration methodology was developed by consensus and was designed to allow the evaluation of the maximum number of blanket washes given the resources available to the project. Performance data were collected for each product in two distinct phases: 1) a laboratory test of the chemical and physical properties and the efficacy of the substitute products, and 2) evaluations conducted in a production setting at volunteer printing facilities. The intent of the laboratory evaluations was to independently measure some of the properties of the washes, such as volatile organic compound (VOC) content, and to assure that the blanket washes sent to volunteer printers would provide an acceptable level of performance. Facility demonstrations were undertaken at the request of printers participating in the DfE project so that blanket washes could be evaluated under the more variable conditions of production runs at printing facilities. It should be noted that the performance demonstrations are not rigorous scientific investigations. Instead, much of this chapter documents the printers' experiences with and opinions of these products as they were used in production at their facilities.

Participation in the demonstration project was open to all blanket wash manufacturers. Prior to the start of the demonstrations, the DfE project staff contacted nearly 100 blanket wash manufacturers to explain the project goals and request their submission of a product. All those who responded and submitted blanket washes were included in the first phase of the demonstrations.

4.1.2 Methodology

The performance evaluation methodology developed by the workgroup is described below and covers both the laboratory testing protocol and the on-site demonstrations methodology. In developing the methodology, the workgroup agreed that product names would be masked. Neither the volunteer printers nor the DfE observers knew the manufacturer of the products being evaluated. Trade names are not listed in this report, instead the blanket washes are referenced by a numerical code and a genericized chemical formulation. This agreement to mask product names was made for several reasons:

- The chemical formulations of commercial products containing distinct chemicals are frequently considered proprietary. Manufacturers of these products typically prefer not to reveal their chemical formulations because a competitor can potentially use the disclosed formulation to sell the product, often at a lower price, since the competitor did not have to invest in research and development.

- The performance of products may vary depending on use and shop conditions, and suppliers were concerned about the characterization of the performance of their products.

- The EPA was concerned about appearing to endorse brand name products that fared well in the CTSA evaluation.

In the initial stages of the Lithography Project the Project partners chose VM&P Naphtha as the baseline against which to compare the 36 substitute blanket washes. VM&P Naphtha, composed of 100% solvent naphtha, light aliphatic and referred to as formulation 28 in certain sections of the text, was chosen primarily because it is well known among lithographers as an effective blanket wash. Many lithographers have used VM&P in their shops and know how it works in their applications and what it costs. VM&P is known to be highly effective at very low cost, however, because of its high VOC content (100%) printers are searching for formulations to replace it.

As the Performance Demonstration was being conducted, some suppliers who had submitted blanket washes chose to withdraw. Their reasons included not wishing to reveal to EPA their complete formulations or concern over the potential results of the performance tests. The

formulations that were withdrawn after work had already begun were numbers 2, 13, and 15. For this reason, those numbers are missing from all the tables in the CTSA.

Laboratory Evaluations

Laboratory testing was carried out by GATF in Pittsburgh, Pennsylvania. A total of 36 products were submitted plus the baseline. For each wash, the flash point, VOC content, and pH were tested. The vapor pressure of the product was not tested, but was submitted by the supplier. Two additional tests, a blanket swell test and a wipability test, were conducted to determine the efficacy of each wash prior to sending it out for field demonstrations. Only products that passed this functional demonstration stage were used in the field demonstration portion of the project. For both of these tests, GATF followed the manufacturer's instructions for diluting or mixing the product.

The blanket swelling potential of each product was tested to determine the effect of the wash on the blankets. The procedure used (detailed in Appendix C) involved measuring the thickness of the blanket test square (2 x 2 inches), maintaining contact between the test square and the wash for one hour, and taking another thickness measurement to calculate the percent swell. Another measurement is taken after 5 hours. Any wash where the blanket swell exceeded 3 percent after 5 hours indicated that the wash may dimensionally distort the blanket and was eliminated from field demonstrations.

Washability of each blanket wash was evaluated using both a wet and a dry ink film (detailed in Appendix C). To measure the washability, a standard volume of ink was evenly applied to a section of a new, clean test blanket. A measured volume of the wash was applied to a cleaning pad. The pad was attached to a mechanized scrubber and the number of strokes required to remove the wet ink were recorded. The procedure was repeated for a dry ink film where the ink was dried with a blow dryer for 20 minutes prior to the cleaning. The dry ink and wet ink tests were repeated for each alternative blanket wash submitted. Any wash where more than 100 strokes were required to clean the blanket (with cleanliness determined by using a reflective densitometer) was eliminated from the field demonstrations.

Based on the results of the blanket swell and the washability tests, 22 of the original 36 products submitted (plus the baseline) qualified for further evaluation through field demonstrations. Prior to shipping substitute blanket washes to printers for these on-site evaluations, each wash was repackaged into a generic container so that those printers demonstrating the products did not know the manufacturer or product name. Masked Material Safety Data Sheets (MSDSs) were also developed and shipped along with the substitute blanket washes to be evaluated.

Printing Facility Demonstrations

PIA affiliates recruited printers located in the Boston, Baltimore, and Washington, D.C. areas, who volunteered their facilities and their time to conduct the field demonstrations of the substitute products. A total of 17 facilities participated. Each substitute product was demonstrated at two facilities and each facility demonstrated a minimum of two and up to five different blanket washes. The product brand name was replaced with a blanket wash number so that the demonstration facilities did not know what product they were using. In addition, the facility names have been replaced with a facility number. A list of participating facilities appears at the front of this document.

To start the on-site demonstration, an "observer" from the DfE project visited each of the volunteer facilities. DfE observers were not EPA employees, but were drawn from staff of the contractor, Abt Associates Inc. The observers called each facility to review the details of their operation, discuss the goals of the project, and to schedule a site visit. The substitute products,

a baseline product, MSDSs, application instructions, and a measuring device were shipped to each facility prior to the DfE observer's arrival.

During each one-day site visit, the observer collected information on the background of the facility, as well as data specific to blanket wash performance. Background data included information on the size of the presses, the number of employees, and current blanket washing practices. After collecting the initial background data, the observers documented information on three types of blanket washes: the blanket wash currently used at the facility, a baseline blanket wash, and the substitute wash. All information was recorded on an Observer's Evaluation Sheet (see Appendix D). Starting with their standard wash, the press operator cleaned the blanket while the observer recorded the quantity of wash used, the time required to clean the blanket, the length of the run, the type and color of the ink on the blanket, and the number of wipes used. After restarting the press, the press operator was asked to comment on the effectiveness of the blanket wash and to determine if there were any changes in subsequent print quality that could be attributed to the blanket wash. This procedure was then repeated using Blanket Wash 28, VM&P Naphtha, the selected baseline. Naphtha was used at all participating facilities. By comparing the differences in the performance of the baseline at the two different facilities, any significant effects of facility-specific operating conditions (e.g., the type of ink, size of blanket, and operator's effort) on the performance of the substitute wash were more apparent. After cleaning the blanket with the baseline wash, the press operator then used the substitute wash provided. The observer recorded the same type of information as was recorded for both the current wash and the baseline wash. The total number of washes required varied from one facility to the next, since the observer was on-site for one day and recorded information on as many washes as were required during production that day.

After the observer's visit, the facility continued to use the substitute wash for one week. During the week, the printer at each volunteer print shop was asked to record information on product performance. The data recorded were similar to that collected by the on-site observer. However, the Printer's Evaluation Sheets (Appendix D) were simplified in an effort to minimize volunteer printers' burden and production disruptions. Facility background information such as the press size and type of shop towel used were recorded by the observer only. At the end of the week, the observer interviewed the press operator to obtain an overall opinion of the product. The exit interview information was recorded on another standardized form (Appendix D).

4.1.3 Data Collection, Summary and Analysis

The information summarized in the following section comes from five sources.

- Laboratory results: the chemical characteristics and the results of the blanket swell and washability tests were reported for each wash.

- Facility background information: the observer collected information on operating conditions while on-site at each volunteer print shop.

- Observer's data: DfE observers recorded information on the performance of the facility's current blanket wash, a baseline wash, and the substitute blanket wash.

- Printer's data: press operators recorded performance data for each blanket wash completed during the week-long demonstration of the substitute blanket wash.

- Follow-up interviews: observers interviewed the press operators at the end of the week-long demonstration on their overall opinion of the substitute blanket wash.

For each of the 22 substitute blanket washes in the field demonstrations, data from the sources mentioned above were analyzed and are summarized in this section. The experiences of the two facilities who demonstrated each product are presented individually. As part of the

analysis, a number of correlations were attempted for each facility but the results were typically not statistically significant due to small sample size. These analyses were run to determine if variations in the printer's opinion of the effectiveness of the blanket depended on any other variables such as ink coverage, effort and time spent on blanket washing, or run length. Where appropriate, these results are included within the following text summaries of each substitute blanket wash. Additionally, some summary statistics, such as average amount of product used, are presented in accompanying tables (Table 4-1).

4.1.4 Limitations

The widely variable conditions between and within printing facilities, the limited number of facilities, and the short duration of the performance demonstrations does not allow the results to be interpreted as definitive performance testing of the blanket washes. In addition, some facilities did not provide the full complement of evaluation forms because they found the performance of the substitute wash to be unacceptable and they discontinued use before the end of the week.

As mentioned previously, the performance demonstrations are not scientifically rigorous but are subjective assessments which reflect the conditions and experience of two individual print shops. There are a number of reasons why the results of performance demonstrations for any given blanket wash may differ from one facility to another. Among these reasons are:

- Variability in operating conditions. Because performance demonstrations were carried out during production runs, many factors which affect the performance of the blanket washes were not controlled during the evaluations including: ink type, ink coverage, condition of the blanket, the length of the run prior to blanket cleaning, and the ambient conditions such as temperature, humidity, and ventilation.

- Variability of print jobs. Different types of jobs had different requirements for blanket cleanliness. Observers noticed that what one facility considers to be a clean blanket another facility may find unacceptable.

- Variability of staff involved in performance demonstrations. Press operators' attitudes towards alternative blanket washes differ from one operator to the next and can affect their perception of performance. As previously mentioned, some of the information recorded was subjective and varied depending on a variety of factors including the attitude, perception, and previous experiences of the operator. For example, many of the substitute products were low in VOC content and did not evaporate as quickly as some of the more traditional blanket washes. Often, an extra step was needed to wipe the blanket with a dry rag to remove a residue left by some of the substitute washes. While extra cleaning steps can be time consuming and lead to increased production costs, even a minimal extra effort was regarded as an unacceptable burden by some operators. Other operators understood that some changes in their procedures and even some extra effort may be needed in order to effectively clean the blanket with an alternative product.

- Variability in application method. Press operators' overall opinion of the blanket wash could have been affected by their current application method. For example, operators who are accustomed to using high solvent blanket washes where little effort is required may differ in their opinion of "moderate effort" from operators who are currently using an alternative where some extra effort is already required. All manufacturers were asked to supply application procedures for their product. When instructions were supplied, the observer reviewed the procedures with the press operators, verified the correct procedure was used when the observer was on-site, and asked in the interview at the end of the week

Table 4-1. Blanket Wash Laboratory Test Results

Form. No.	Flash Point (°F)	VOC Content[1] (lbs/gal; % by weight)	pH	Blkt Swell		Wet Ink Film				Dry Ink Film			
				1 hr (%)	5 hr (%)	Blanket Density	Ink Density	Blanket Cleaned	Strokes	Blanket Density	Ink Density	Blanket Cleaned	Strokes
1	230+	2.3; 30%	7.8*	1.5	3.0	1.32	1.66	1.38	4	1.32	1.47	1.34	6
3	114	6.4; 91%	3.4*	1.5	4.5	1.33	1.76	1.34	4	1.32	1.49	1.34	4
4	114	6.4; 89%	8.7	3.0	5.2	1.32	1.85	1.33	3	1.32	1.47	1.36	2
5	139	2.5; 30%	4.3	6.1	15.4	1.31	1.79	1.33	9	1.33	1.49	1.37	8
6	152	3.5; 47%	5.5	0.7	1.5	1.32	1.81	1.34	8	1.33	1.52	1.35	6
7	165	3.0; 36%	9.3	3.8	6.8	1.27	1.73	1.36	6	1.31	1.51	1.36	8
8	115	3.3; 41%	4.0	7.7	20	1.32	1.79	1.34	7	1.33	1.47	1.34	9
9	230+	0.77; 10%	4.6	1.5	1.5	1.33	1.74	1.36	19	1.32	1.52	1.44	30
10	230+	0.16; 2%	5.7	0.7	0.7	1.28	1.78	1.42	12	1.28	1.47	1.29	13
11	150	4.3; 61%	5.0*	0.0	1.5	1.32	1.66	1.41	4	1.32	1.46	1.35	5
12	125	1.3; 20%	8.2	0.0	1.5	1.33	1.79	1.36	7	1.32	1.47	1.31	11
14	230+	0.97; 12%	5.0	1.5	3.0	1.28	1.79	1.31	8	1.29	1.51	1.32	10
16	145	7.2; 99%	9.8	4.5	10.6	1.25	1.64	1.30	2	1.30	1.51	1.34	2
17	220+	0.051; 0.6%	9.8	1.5	1.5	1.27	1.62	1.54	100	1.32	1.48	1.48	100
18	150	4.4; 60%	5.5	1.5	4.5	1.32	1.71	1.36	8	1.32	1.55	1.36	7
19	230+	1.8; 22%	4.6	1.5	1.5	1.28	1.79	1.33	11	1.27	1.45	1.30	9
20	170	2.7; 35%	7.1	0.0	1.5	1.30	1.77	1.34	5	1.29	1.52	1.34	7
21	115	3.5; 47%	6.2	0.0	1.5	1.32	1.56	1.41	7	1.31	1.43	1.42	6

Form. No.	Flash Point (°F)	VOC Content[1] (lbs/gal; % by weight)	pH	Blkt Swell		Wet Ink Film				Dry Ink Film			
				1 hr (%)	5 hr (%)	Blanket Density	Ink Density	Blanket Cleaned	Strokes	Blanket Density	Ink Density	Blanket Cleaned	Strokes
22	157(a)	NM; 2.17%	7.4(b)	1.5	[2]1.5	1.28	1.67	1.37	13	1.28	1.48	1.41	13
23	140	0.48; 6%	9.2	0.0	1.5	1.28	1.76	1.31	24	1.28	1.51	1.33	100
24	100	1.5; 19%	9.9	1.5	3.0	1.32	1.77	1.34	15	1.31	1.45	1.34	12
25	220+	4.1; 55%	4.3	3.0	4.5	1.27	1.73	1.36	22	1.33	1.53	1.49	32
26	230+	1.3; 18%	7.8*	0.0	0.0	1.28	1.73	1.33	6	1.32	1.48	1.40	14
27	145	7.2; 93%	3.9	3.0	4.5	1.27	1.67	1.30	3	1.33	1.55	1.35	3
28	50	6.2; 100%	6.6	1.5	3.0	1.33	1.80	1.32	3	1.33	1.51	1.33	8
29	230+	2.1; 30%	7.2	1.5	1.5	1.32	1.74	1.41	9	1.32	1.47	1.39	18
30	100(a)	0.48; 7%	7.6(b)	0.7	1.5	1.29	1.66	1.29	5	1.27	1.50	1.24	11
31	105	6.6; 99%	7.6	1.5	3.0	1.32	1.78	1.31	3	1.32	1.51	1.34	3
32	220	6.5; 99%	8.5	0.1	1.5	1.27	1.71	1.33	5	1.29	1.45	1.40	30
33	105	3.4; 46%	7.2*	4.5	7.6	1.27	1.77	1.28	4	1.31	1.45	1.35	4
34	138	2.8; 39%	6.6	1.5	3.0	1.32	1.79	1.35	10	1.32	1.49	1.35	20
35	105	6.7; 99%	6.0	1.5	6.1	1.32	1.76	1.35	3	1.33	1.46	1.34	5
36	175	3.5; 48%	5.7*	0.7	1.5	1.33	1.78	1.38	4	1.33	1.48	1.37	5
37	82	1.0; 14%	3.9	3.0	3.0	1.33	1.85	1.34	5	1.33	1.49	1.34	8
38	230+	4.9; 65%	5.6	0.0	1.5	1.32	1.76	1.43	9	1.32	1.48	1.37	16
39	155	2.9; 37%	9.2	1.5	3.0	1.29	1.73	1.31	7	1.31	1.50	1.34	10
40	155	3.8; 52%	4.8	1.5	3.0	1.33	1.81	1.39	5	1.33	1.51	1.35	10

(a) full strength (b) 25% NM - not measured * pH fluctuates wildly and may not be valid

[1]VOC content in lbs/gal was measured at GATF; % by weight VOC was calculated based on information submitted by the manufacturer.
[2]VOC content in lbs/gal was not measurable; % by weight VOC was submitted by the manufacturer.

if the application procedures had been modified in any way. If any changes were made, the type of change and the reason for the change are described in the performance summary.

- *Short term nature of the demonstrations.* Printers used the substitute blanket washes in their facilities for one week. Any long term effects such as premature blanket wear or corrosion would not have been apparent.

4.1.5 Blanket Wash Summaries

A summary of the performance of each of the 22 substitute blanket washes follows. Since the trade names of the substitute blanket washes are not given in this document, each blanket wash is identified by a numerical code and a generic chemical formulation. The specific types of chemicals that make up each of the generic formulations are explained in greater detail in Chapter 2. In addition, the facility names have been replaced with a facility number.

Performance of each product is presented separately for the two facilities, and includes a description of the facility's current blanket wash, their past experience in testing alternative blanket washes, their overall opinion of the substitute wash performance, and, if applicable, a summary of the factors that may have influenced performance. A table is also included for each blanket wash which presents the results of the laboratory test of both the substitute blanket wash and the baseline wash. Averages of the volume of wash used, time required, and effort required, as recorded by the printers during field demonstrations are also included in each product performance table. In addition, a summary table is provided that consolidates the results from all products into a single table (Table 4-2).

Table 4-2. Summary of Blanket Wash Performance Demonstrations

	Laboratory Results		Field Demonstration Results	
Product/ Facility	**VOC Content** (lbs/gal; % by wt)	**Flash-point** (°F)	**Avg Volume Used** (ounces)	**Performance Evaluation**
WASH 1				
Facility 3	2.3; 30%	230+	1.1 ± 0.2 [1.0][a]	Based on a sample size of 10 blanket washes: • Good performance for light or medium ink coverage. • Poor performance for heavy ink coverage; the extra time and effort needed were unacceptable. • Left a slight residue that was removed with a dry rag.
Facility 6			1.5 ± 0.6 [1.5][a]	Based on a sample size of 4 blanket washes: • Poor performance. • Print quality problems: image of the previous job was showing.
WASH 6				
Facility 11	3.5; 47%	152	1.0 ± 0.2 [0.7 ± 0.2][a]	Based on a sample size of 11 blanket washes: • Wash left oily residue that interfered with print quality. • Did not readily absorb into rag due to thick consistency; created delays. • Fair performance overall; more effort required with heavy ink coverage.
Facility 15			0.9 ± 0.2 [1.5 ± 0.7][a]	Based on a sample size of 23 blanket washes: • Cut ink well. • Did not readily absorb into rag due to thick consistency; created delays and effort necessary to clean was rated "high." • Did not leave a residue on the blanket.
WASH 9				
Facility 10	0.77; 10%	230+	3.1 ± 0.3 [1.5][a]	Based on a sample size of 4 blanket washes: • Poor performance. • Did not cut ink well, required excessive effort, and did not soak into rag. • Discontinued use of Wash 9 after 4 washes.
Facility 15			0.7 ± 0.1 [1.5 ± 0.7][a]	Based on a sample size of 21 blanket washes: • Poor performance. • Did not soak into the rag. • Required much more effort than the baseline.
WASH 10				
Facility 3	0.16; 2%	230+	1.0 ± 0.0 [1.0][a]	Based on a sample size of 4 blanket washes: • Printer declined to test product due to level of effort required to clean blanket. • Did not absorb well into rag. • Did not cut ink well.
Facility 4			3.0 ± 0.0 [3.0 ± 0.0][a]	Based on a sample size of 4 blanket washes: • Printer declined to test product due to level of effort required to clean blanket. • Did not absorb well into rag. • Did not cut ink well.

	Laboratory Results		Field Demonstration Results	
Product/ Facility	**VOC Content** (lbs/gal; % by wt)	**Flash-point** (°F)	**Avg Volume Used** (ounces)	**Performance Evaluation**
WASH 11				
Facility 1	4.3; 61%	150	2.5 ± 0.6 [2.5 ± 0.0][a]	Based on a sample size of 26 blanket washes: • Good performance for light/medium coverage. • Poor performance for heavy ink coverage; extra time and effort were needed. • Left slight, oily residue on blanket, but it did not affect the print quality.
Facility 2			1.5 ± 1.5 [1.2 ± 0.8]	Based on a sample size of 31 blanket washes: • Good/Fair performance for light/medium cover. • Poor performance for heavy ink coverage; extra product, time and effort were required. • Left slight, oily residue on blanket, but it did not affect the print quality.
WASH 12				
Facility 12	1.3; 20%	125	5.4 ± 0.8 [4.4 ± 1.6]	Based on a sample size of 16 blanket washes: • Was considered equal to baseline wash in overall performance. • Had difficulty cutting paper residue. • Wash was diluted 50% with water.
Facility 13			1.8 ± 0.4 [2.1 ± 0.5]	Based on a sample size of 19 blanket washes: • When not diluted with water, performance surpassed baseline and standard washes. • Averaged over all dilution levels, required slightly less effort than baseline wash. • Overall fair performance rating across ink coverages and dilutions.
WASH 14				
Facility 6	0.97; 12%	230+	1.3 ± 0.6 [1.5]	Based on a sample size of 15 blanket washes: • Good performance; cut ink well. • Extra effort was required to remove the oily residue that the wash left on the blanket.
Facility 16			2.8 ± 0.5 [2.0 ± 0.0]	Based on a sample size of 34 blanket washes: • Did not cut ink as well as the baseline wash. • Black inks and heavy ink build up are especially difficult to clean. • Thick consistency of the wash made it difficult to soak into rag.

	Laboratory Results		Field Demonstration Results	
Product/ Facility	**VOC Content** (lbs/gal; % by wt)	**Flash-point** (°F)	**Avg Volume Used** (ounces)	**Performance Evaluation**
WASH 19				
Facility 18	1.8; 22%	230+	4.8 ± 3.0 [1.5 ± 0.8][a]	Based on a sample size of 5 blanket washes: • Thick consistency of wash made it difficult to soak into rag and resulted in uneven application. • Large quantities were required to cut ink.
Facility 19			2.2 ± 0.5 [0.9 ± 0.2]	Based on a sample size of 8 blanket washes: • Thick consistency of wash was messy and difficult to use. • Cut demonstration short due to extra effort and time required to clean blanket.
WASH 20				
Facility 11	2.7; 35%	170	1.4± 0.6 [0.7± 0.2]	Based on a sample size of 17 blanket washes: • Performance considered fair, but worse than facility and baseline washes. • Left oily residue on blanket that required additional rotations to remove. • Hard to apply to rags due to thick consistency.
Facility 12			3.0 [4.4± 1.6]	Based on a sample size of 1 blanket washes: • Product induced nausea in press operators; Facility declined opportunity to test product.
WASH 21				
Facility 6	3.5; 47%	115	2.0 ± 0.6 [1.5]	Based on a sample size of 6 blanket washes: • Fair performance. • Cut ink well, but oily residue was difficult to remove. • Extra waste sheets required to get back up to color because of residue.
Facility 17			1.6 ± 0.4 [1.5 ± 0.4]	Based on a sample size of 25 blanket washes: • Fair performance. • Oily residue caused print problems if it was not completely removed. • Wash did not absorb into rag easily.
WASH 22				
Facility 12	Not measurable; 2.17%[b]	157	4.4 ± 0.6 [4.4 ± 1.6]	Based on a sample size of 5 blanket washes: • Cut ink as well as baseline wash. • Did not readily soak into rag, creating delays. • Fair performer overall.
Facility 13			3.4 ± 1.7 [2.1 ± 0.5]	Based on a sample size of 17 blanket washes: • Difficult to apply to rag due to thick consistency. • Left blanket slightly streaked and wet, extra drying time necessary to prevent print quality problems. • Cut ink as well as baseline wash, but required greater effort; a fair performer.

	Laboratory Results		Field Demonstration Results	
Product/ Facility	**VOC Content** (lbs/gal; % by wt)	**Flash-point** (°F)	**Avg Volume Used** (ounces)	**Performance Evaluation**
WASH 24				
Facility 16	1.5; 19%	100	2.2 ± 0.6 [2.0 ± 0.0]	Based on a sample size of 28 blanket washes: • Cut ink well, but some extra effort was required to wipe off oily residue. • Oily residue significantly increased the number of copies required to return to print quality.
Facility 17			1.3 ± 0.6 [1.5 ± 0.4]	Based on a sample size of 4 blanket washes: • Cut ink well. • Extra effort to wipe off oily residue. • Thick consistency of wash caused operator to curtail use. • Citrus odor was very strong to operator.
WASH 26				
Facility 5	1.3; 18%	230+	0.5± 0.1 [1.0]	Based on a sample size of 14 blanket washes: • Good performance rating after every wash. • Performed as well as both standard facility wash and baseline wash. • Slight oily residue caused print quality problems when wash was used for roller clean-up.
Facility 15			0.7± 0.1 [1.5± 0.7]	Based on a sample size of 22 blanket washes: • Good performance rating after every wash. • Performed as well as standard facility wash and baseline wash.
WASH 29				
Facility 7	2.1; 30%	230+	1.0 ± 0.0 [1.2 ± 0.0]	Based on a sample size of 3 blanket washes: • Good performance; cut ink well. • Extra effort was required to dry the blanket.
Facility 8			0.8 ± 0.6 [0.7 ± 0.0]	Based on a sample size of 36 blanket washes: • Did not cut ink as well as baseline wash. • Did not cut paper dust or powder. • More effort was required to remove slight oily film on blanket.
WASH 30				
Facility 18	0.48; 7%	100	4.0 ± 0.0 [1.5 ± 0.8]	Based on a sample size of 3 blanket washes: • Good performance; cut ink well. • Worked best with no dilution with water.
Facility 19			0.7 ± 0.0 [0.9 ± 0.2]	Based on a sample size of 8 blanket washes: • Cut ink well. • Required extra effort to dry oily film from blanket. • Thick consistency was difficult to use. • Extra effort was required due to resistance to surface of the blanket.

	Laboratory Results		Field Demonstration Results	
Product/ Facility	**VOC Content** (lbs/gal; % by wt)	**Flash-point** (°F)	**Avg Volume Used** (ounces)	**Performance Evaluation**
WASH 31				
Facility 7	6.6; 99%	105	1.5 ± 0.6 [1.2 ± 0.0][a]	Based on a sample size of 4 blanket washes: • Cut the ink well; slightly more effort needed to remove oily residue on blanket. • Oily residue slightly increased the copies required to return to print quality. • Smell not as strong as facility's standard wash or baseline wash.
Facility 8			1.1 ± 1.5 [0.7 ± 0.0]	Based on a sample size of 61 blanket washes: • Good performance; cut ink well • Performed as well as standard wash. • Slightly more effort was required due to resistance to surface of the blanket.
WASH 32				
Facility 1	6.5; 99%	220	2.5 ± 0.0 [2.5 ± 0.0]	Based on a sample size of 4 blanket washes: • Good performance. • Required slightly higher effort to remove excess wash than with the standard wash.
Facility 5			0.7 ± 0.2 [1.0]	Based on a sample size of 12 blanket washes: • Good performance. • Left slight, oily residue that was removed with dry rags and did not affect print quality.
WASH 34				
Facility 1	2.8; 39%	138	2.5 ± 0.0 [2.5 ± 0.0]	Based on a sample size of 37 blanket washes: • Good performance; best of the 5 substitute washes demonstrated at this facility. • Cut the ink well with the same effort as with the standard wash for light/medium ink coverage. • Slightly more effort needed for heavy ink coverage, but acceptable.
Facility 19			1.2 ± 0.4 [0.9 ± 0.2]	Based on a sample size of 13 blanket washes: • Fair/Poor performance. • Cut the ink well, but did not soak into rag and extra effort was needed to remove the oily residue.
WASH 37				
Facility 3	1.0; 14%	82	1.3 ± 0.6 [1.0]	Based on a sample size of 17 blanket washes: • Longer drying time than baseline and standard facility washes. • Performance rated as good and fair on light and medium coverages, respectively. • Press operators had no problems with wash.
Facility 4			2.2 ± 0.8 [3.0 ± 0.0]	Based on a sample size of 6 blanket washes: • Worked well initially, but caused paper breakup due to blanket tackiness. • Use of wash discontinued.

	Laboratory Results		Field Demonstration Results	
Product/ Facility	**VOC Content** (lbs/gal; % by wt)	**Flash-point** (°F)	**Avg Volume Used** (ounces)	**Performance Evaluation**
WASH 38				
Facility 2	4.9; 65%	230+	2.2 ± 0.6 [1.2 ± 0.8][a]	Based on a sample size of 9 blanket washes: • Oily residue caused print quality problems. • Use of wash discontinued after 1.5 days due to poor performance and print quality problems.
Facility 4			3.7 ± 1.3 [3.0 ± 0.0]	Based on a sample size of 6 blanket washes: • Use of wash discontinued after 6 trials due to print quality problems from oily residue. • Wash cut ink satisfactorily.
WASH 39				
Facility 5	2.9; 37%	155	0.7 ± 0.3 [1.0]	Based on a sample size of 32 blanket washes: • Good overall performance; cut ink well. • Did not dry as quickly as baseline wash and left an oily residue on the blanket. • Product did not work on rollers.
Facility 8			1.0 ± 0.0 [0.7 ± 0.0]	Based on a sample size of 5 blanket washes: • Did not cut ink well and therefore required extra time and effort to clean blankets. • Difficult to get wash to soak into rag. • Left oily residue on blanket.
WASH 40				
Facility 1	3.8; 52%	155	2.5 ± 0.0 [2.5 ± 0.0]	Based on a sample size of 6 blanket washes: • Good performance. • When diluted with water, left residue. No residue problem at full strength.
Facility 10			0.9 ± 0.2 [1.5 ± 0.0]	Based on a sample size of 20 blanket washes: • Good performance; cut ink well. • Required slightly more effort when coverage was heavy.

[a] Bracketed values ([]) are the results using the baseline wash (VM&P Naphtha) to clean the same blanket as was used in the demo at this facility.
[b] VOC content not measurable; % by weight VOC content was reported by manufacturer.

Blanket Wash 1

Composition:
Fatty acid derivatives
Alkoxylated alcohols

VOC Content: 30%; 2.3 lbs/gal
Flashpoint: 230+°F
pH: 7.8 (fluctuates wildly)

Facility 3

Facility 3 used Wash 1 for one week on a two-unit, 18" x 25" press. During the demonstration week, the facility used conventional inks to print letterhead and brochures. The standard blanket wash at Facility 3 contains aliphatic hydrocarbons, aromatic hydrocarbons, and alcohol, according to the MSDS. Facility 3 had recently tried a sample of another substitute blanket wash, but found it to be too oily; they had difficulty removing the residue from the blanket. In their typical cleaning procedure, the press operator pours the wash onto a reusable shop towel from a squirt bottle, and wipes the ink off the blanket. Both the baseline wash and the facility's standard product evaporated quickly and there was no need to remove excess wash.

For light or medium ink coverage, the press operator evaluated the performance of Wash 1 as "fair;" it removed the ink well, but left an oily residue on the blanket. To remove this residue, the press operator had remove the excess wash from the blanket with a dry shop towel. The press operator felt the extra effort of the drying step required for Wash 1 was minimal, and if that were the only disadvantage to Wash 1, he would have considered using the product regularly. However, in the case of heavy ink coverage, performance was considered "poor;" Wash 1 did not cut the ink well, even when the product was applied twice. The press operator felt the effort, time, and product needed to clean a blanket with heavy ink coverage were excessive.

Facility 6

Facility 6 prints credit cards and identification cards on plastic sheets using conventional inks. Wash 1 was used on a single-unit, 18" x 25" press. Currently, this facility cleans their blankets using a wash which, according to the MSDS, consists of aliphatic petroleum distillates, aromatic petroleum distillates, 1,2,4-trimethylbenzene, nonylphenoxypoly (ethyleneoxy) ethanol, diisononyl phthalate, 2,6,-di-tert-butyl-p-cresol. Each blanket is typically wiped down four times during cleaning: three times to remove the ink with reusable shop towels soaked with blanket wash, and once with a shop towel soaked with a more volatile cleaner to thoroughly dry the blanket. Blanket wash is applied to the shop towel using a squirt bottle and the last shop towel from the previous wash is used as the first shop towel on the next wash. The same shop towels are used until there is too much ink build-up on the shop towel to effectively remove ink. The application procedure was modified slightly for both the baseline wash and the substitute wash during the performance demonstration; a dry shop towel was used to dry the blanket rather than a drying solution.

This facility did not use Wash 1 for the full week-long demonstration period. While on-site, the observer recorded the data for four blanket washes. During this time, the performance of Wash 1 was categorized as "good" by the operator; the product cut the ink well and the blanket appeared to be clean. Compared to the baseline product, slightly more effort and time were required for Wash 1 (an average of 4 rotations or 75 seconds) than for the baseline wash (2 rotations or 38 seconds). The operator found the baseline product worked very well; it cut the ink and dried

quickly after wiping the blanket with one dry wipe, whereas the substitute wash required at least two drying rotations to fully remove excess wash from the blanket with a dry shop towel.

After the observer's visit, the press operator continued to use Wash 1. He recorded information on four more washes, rating the performance as "good." For all of these washes, ink coverage was medium. He found the product had no odor, which he preferred to the unpleasant odor of this facility's standard product. However, after four blanket cleanings, the press operator noticed problems with the subsequent print job. He found that the blanket did not take the ink well and that the image of the previous job was showing up on the next job printed. The press operator felt these problems with print quality were associated with Wash 1 and he discontinued using the product. After switching back to his standard wash, he did not experience further problems with print quality.

Upon interviewing the press operator at the end of the demonstration, he felt that the product's overall performance was "poor." This is not reflected in the data since the printer discontinued using the product before he noticed the print quality problems.

Summary of Performance Demonstrations for Blanket Wash 1

Laboratory Testing Results								
Product	**VOC Content (lbs/gal; % by wt)**	**pH**	**Flashpoint (°F)**	**Vapor Pressure (reported, mm Hg)**	**Blanket Swell (%)**		**Washability (# strokes)**	
					1 hour	***5 hour***	***Wet Ink***	***Dry Ink***
WASH 1	2.3; 30%	7.8 (fluctuated during test)	230+	0.1 @ 80°F	1.5	3	4	6
Baseline Wash	6.2; 100%	6.6	50	15 @ 100°F	1.5	3	3	8

Field Demonstration Results								
Product/ Facility	**Average Volume Used (ounces)**	**Time required[b] (# rotations)**			**Physical Effort Required (Low, Medium, or High)**			**Performance Evaluation**
		Light Coverage	*Medium Coverage*	*Heavy Coverage*	*Light Coverage*	*Medium Coverage*	*Heavy Coverage*	
WASH 1 at Facility 3	1.1 ± 0.2 (n=10)[a]	2.0 ± 0.0	2.2 ± 0.5	2.5 ± 0.7	Medium	Medium	High	*Based on a sample size of 10 blanket washes:* • Good performance for light or medium ink coverage. • Poor performance for heavy ink coverage; the extra time and effort needed were unacceptable. • Left a slight residue that was removed with a dry shop towel.
Baseline Wash at Facility 3	1.0 (n=1)	NA	1	NA	NA	Medium	NA	• Good performance. • It dried quickly and removing excess wash with a dry shop towel was not required.
WASH 1 at Facility 6	1.5 ± 0.6 (n=4)	NA	4.0 ± 0.0	NA	NA	Medium	NA	*Based on a sample size of 4 blanket washes:* • Poor performance. • Print quality problems: image of the previous job was showing.
Baseline Wash at Facility 6	1.5 (n=1)	NA	2	NA	NA	Low	NA	• Good performance • Cut the ink well without extra effort.

NA = Not Applicable; product was not demonstrated under these conditions.

[a] n = number of washes on which this data is based, as recorded by the printer.

[b] Time required to clean the blanket measured by the number of blanket rotations: Avg. time per rotation = 18.8 sec. at Facility 3 and 13.8 sec. at Facility 6 (based on time recorded by the observer)

Blanket Wash 6

Composition:
Fatty acid derivatives
Hydrocarbons, petroleum distillates
Solvent naphtha (petroleum), heavy aromatic
Alkyl benzene sulfonates

VOC Content: 47%; 3.5 lbs/gal
Flashpoint: 152°F
pH: 5.5

Facility 11

Wash 6 was tested on a 5-unit, 19" x 26" press at Facility 11. During the performance demonstration, conventional and vegetable-based inks were used to produce commercial products such as brochures, publications, and mailings. Facility 11 had tried using alternative blanket washes for worker health and safety or environmental reasons on four occasions prior to the performance demonstration, but use of all four products had been discontinued due to odor problems. Currently, Facility 11 uses a blanket wash which, according to the MSDS, consists of petroleum naphtha, dipropylene glycol methyl ether, and 1,8(9)-nenthadiene. Normal blanket wash procedure consists of three wipes with a reusable shop towel saturated with blanket wash, followed by a single wipe with a clean dry shop towel to remove excess wash and dry the blanket. The blanket wash is applied to the shop towel with a squirt bottle. If possible, the shop towels were used to clean more than one blanket. This standard application method was also used for the performance demonstration.

On average, Wash 6 and the baseline wash received performance ratings of fair on the good-fair-poor scale across all ink coverages. The baseline wash was used on light and medium ink coverages, whereas Wash 6 performance was demonstrated at all levels of ink coverage. Wash 6 cut the ink as well as the baseline wash and required slightly less time (as measured by blanket rotations) to complete the blanket wash procedures. The effort required to remove ink increased for Wash 6 from a medium to high level on heavy coverage jobs, however, while the effort required to wash the blanket was a medium level for the baseline wash on light and medium ink coverages. Press operators commented that Wash 6 had an especially difficult time cutting black inks.

According to press operators, Wash 6 did not soak into the wipe as well as the baseline or standard facility washes, causing some delays in the blanket wash-up procedure, as press operators waited for the wash to slowly absorb into the shop towel material. Press operators also noticed a slight oily film remaining on the blanket from Wash 6, even after the dry wipe step. The oily residue caused problems with print quality; subsequent print jobs required a greater number of copies than usual to reach acceptable print quality. Wash 6 odor was considered slightly strong by press operators.

Facility 15

Facility 15 used Wash 6 on a brand new, 2-unit, 19" x 25" press to print commercial printing products such as brochures with conventional inks. Facility 15 had experimented with an alternative blanket wash for environmental, worker health and safety reasons prior to the performance demonstration, but had not adopted the wash due to its "ferocious" odor. Standard facility blanket wash was a petroleum naphtha-based product, according to the MSDS. Standard blanket washing procedure consisted of a two wipe process: one reusable cloth shop towel is used to apply the blanket wash to the blanket and remove the ink, and another clean and dry reusable

cloth shop towel is used to remove the excess wash and dry the blanket. The blanket wash is applied to the reusable shop towel with a squirt bottle; a small (approximately one ounce) and relatively consistent quantity of blanket wash is applied for each cleaning. This standard application process was used throughout the performance demonstration.

The press operator who conducted the week-long demonstration felt that Wash 6 performed worse than both the baseline wash and the facility standard wash. The baseline wash received a good performance rating, whereas Wash 6 received a poor rating on the good-fair-poor scale. The press operator's major complaint was that the thick consistency of Wash 6 caused delays during the wash application process; the viscous substitute wash required time to slowly soak into the shop towel material before blanket washing could begin. The press operator experimented with reducing the quantity of blanket wash in order to minimize delays, but the reduced volume was insufficient to finish a blanket in one wash application. The application shop towels were identical in material and size to other reusable laundered shop towels observed at other facilities. The viscosity problem was the only complaint about the substitute wash, however, as it performed well in all other areas. According to the press operator, Wash 6 cut the ink well, did not leave a residue on the blanket, and did not require a greater overall effort to clean the blanket than the baseline wash. The quantity of Wash 6 used to clean a blanket was also less than that of the baseline wash. In the opinion of the press operator, the effort required to apply the substitute wash to the shop towel outweighed these considerations, however. Wash 6 was categorized as requiring a high level of effort. In comparison, the baseline wash required low effort according to the press operator.

Summary of Performance Demonstrations for Blanket Wash 6

Laboratory Testing Results								
Product	**VOC Content (lbs/gal; % by wt)**	**Flashpoint (°F)**	**pH**	**Vapor Pressure (reported, mm Hg)**	**Blanket Swell (%)**		**Washability (# strokes)**	
					1 hour	***5 hour***	***Wet Ink***	***Dry Ink***
WASH 6	3.5; 47%	152	5.5	0.2 @ 68°F	0.7	1.5	8	6
Baseline Wash	6.2; 100%	50	6.6	15 @ 100°F	1.5	3	3	8

Field Demonstration Results								
Product/ Facility	**Average Volume Used (ounces)**	**Time required[b] (# rotations)**			**Physical Effort Required (Low, Medium, or High)**			**Performance Evaluation**
		Light Coverage	*Medium Coverage*	*Heavy Coverage*	*Light Coverage*	*Medium Coverage*	*Heavy Coverage*	
WASH 6 at Facility 11	1.0 ± 0.2 (n=11)[a]	2.5 ± 0.8	2.5 ± 0.6	3.0 ± 0.0	Medium	Medium	High	*Based on a sample size of 11 blanket washes:* • Left oily residue that interfered with print quality. • Did not readily absorb into shop towel due to thick consistency. • Fair performance overall; more effort required with heavy ink coverage.
Baseline Wash at Facility 11	0.7 ± 0.2 (n=4)	3.7 ± 0.6	3.0 ± 0.0	NA	Medium	Medium	NA	• Received good performance rating. • Did not perform as well as facility standard wash.
WASH 6 at Facility 15	0.9 ± 0.2 (n=23)	2.7 ± 0.5	3.6 ± 0.5	3.9 ± 0.4	High	High	High	*Based on a sample size of 23 blanket washes:* •Cut ink well. • Did not readily absorb into shop towel due to thick consistency; created delays and effort necessary to clean was rated "high." • Did not leave a residue on the blanket.
Baseline Wash at Facility 15	1.5 ± 0.7 (n=2)	2.0 ± 0.0	NA	NA	Low	NA	NA	• Cut ink well, with low effort. • Slight odor.

NA = Not Applicable; product was not demonstrated under these conditions.

[a] n = number of washes on which this data is based, as recorded by the printer.

Blanket Wash 9

Composition:
Fatty acid derivatives
Water
Ethoxylated nonylphenol

VOC Content: 10%; 0.77 lbs/gal
Flashpoint: 230+°F
pH: 4.6

Facility 10

At Facility 10, performance demonstrations were conducted on a six-unit, 19" x 28" press using conventional inks. This facility primarily prints commercial products, such as brochures, cards, and posters. Currently, Facility 10 uses a naphtha blend as their standard wash. They have tried a few alternative washes, but found that they either did not work as well, or that they cost more than twice as much as their standard blanket wash. Typically, the facility cleans the blanket as follows: wipe the blanket with a wet sponge to remove built-up paper and particles (1-2 rotations); pour blanket wash onto a reusable shop towel from a squeeze bottle; wipe blanket with product (2 rotations); wipe off excess with a clean, dry shop towel (1-2 rotations). The baseline product and Wash 9 were applied using the same procedure.

When using Wash 9, the operator rated the performance as "poor." After the first four blanket washes, the press operator discontinued use of the product. Compared to the baseline wash, which cut the ink well, the substitute wash required excessive effort and time (up to 12 rotations or 3 minutes, compared to 5 rotations or 1.25 minutes with the baseline wash), and still did not cut the ink. Although none of the four blankets washed had heavy ink coverage, Wash 9 still was not able to remove the ink to the satisfaction of the press operator. Before continuing the print job, the operator cleaned all the blankets again with his standard wash. Additionally, the thick, creamy consistency of the wash did not allow it to soak into the shop towel; this made for a messy application as the wash dripped from the blanket onto the floor and onto other parts of the press during the blanket washing procedure. After the four blanket washes, the operator varied the application procedure somewhat in an effort to improve performance. To try to get the wash to soak into the shop towel, the operator tried using a shop towel dampened with water instead of a dry one to apply the wash. This did not improve the absorption of Wash 9 into the shop towel or the performance in cleaning the blanket. Because this facility re-washed the blankets with their standard product before starting the next print job, it is unclear as to whether this blanket wash would have an affect on future print quality or not.

Facility 15

Facility 15 prints commercial products (brochures), direct-mail products, and other publications. Performance demonstrations at this facility were conducted on a two-unit 19" x 25" press using conventional inks. The standard wash contains aromatic hydrocarbons, polyglycol ether, and aliphatic hydrocarbons, according to the MSDS. The press operator noted that while the standard wash cuts the ink well, it does have somewhat of an odor. In the past, Facility 15 tried an alternative blanket wash, but it did not work well and it had a very offensive odor. Recently, this facility installed a new press with an automatic blanket washer. In their standard blanket washing procedure, the press operator at this facility pours the blanket wash on to a reusable shop towel, wipes the ink off the blanket in one rotation, then uses a dry shop towel for one rotation to remove the excess wash. This procedure was used for both the baseline and the substitute wash.

Over the course of the week, Facility 15 washed 21 blankets with the Wash 9. While the baseline wash performance was "good" and cut the ink well with minimal effort, the overall performance of Wash 11 was consistently rated as "poor" at all levels of ink coverage. The press operator noted several reasons for the poor performance: the thickness of the wash prevented it from soaking into the shop towel thoroughly; when applied to the blanket, Wash 9 did not cut the ink well; it required excessive effort (more than twice as much as the baseline product); and, it did not dry well on the blanket. Although the wash did not seem to affect future print quality, the operator felt he had to carefully and thoroughly dry the blanket to avoid print quality problems.

Summary of Performance Demonstrations for Blanket Wash 9

Laboratory Testing Results								
Product	**VOC Content (lbs/gal; % by wt)**	**Flashpoint (°F)**	**pH**	**Vapor Pressure (reported, mm Hg)**	**Blanket Swell (%)**		**Washability (# strokes)**	
					1 hour	***5 hour***	***Wet Ink***	***Dry Ink***
WASH 9	0.77; 10%	230+	4.6	< 1.0 @ 77°F	1.5	1.5	19	30
Baseline Wash	6.2; 100%	50	6.6	15 @ 100°F	1.5	3	3	8

Field Demonstration Results								
Product/ Facility	**Average Volume Used (ounces)**	**Time required[b] (# rotations)**			**Physical Effort Required (Low, Medium, or High)**			**Performance Evaluation**
		Light Coverage	*Medium Coverage*	*Heavy Coverage*	*Light Coverage*	*Medium Coverage*	*Heavy Coverage*	
WASH 9 at Facility 10	3.1 ± 0.3 (n=4)[a]	11. ± 1.4	11. ± 1.4	NA	High	High	NA	*Based on a sample size of 4 blanket washes:* • Poor performance. • Did not cut ink well, required excessive effort, and did not soak into shop towel. • Discontinued use of Wash 9 after 4 washes.
Baseline Wash at Facility 10	1.5 (n=1)	NA	NA	5	NA	NA	Medium	• Good performance; cut heavy ink coverage well. • Operator noted a strong odor.
WASH 9 at Facility 15	0.7 ± 0.1 (n=21)	3.6 ± 0.5	3.9 ± 0.4	4.7 ± 0.6	High	High	High	*Based on a sample size of 21 blanket washes:* • Poor performance. • Did not soak into the shop towel. • Required much more effort than the baseline.
Baseline Wash at Facility 15	1.5 ± 0.7 (n=2)	2.0 ± 0.0	NA	NA	Low	NA	NA	• Good performance. • Cut ink well with minimal effort.

NA = Not Applicable; product was not demonstrated under these conditions.
NC = Not calculated; VOC content as a % by weight could not be calculated because a specific gravity was not available.
[a] n = number of washes on which this data is based, as recorded by the observer (Facility 10) and by the printer (Facility 15).
[b] Time required to clean the blanket measured by the number of blanket rotations. Avg. time per rotation = 15.0 sec. at Facility 10 and 35.0 sec. at Facility 15 (based on time recorded by the project observer)

Blanket Wash 10

Composition:
Fatty acid derivatives
Water

VOC Content: 2%; 0.16 lbs/gal
Flashpoint: 230+°F
pH: 5.7

Facility 3

Facility 3 used Wash 10 on a 2-unit, 18" x 25" press, using conventional inks to print a variety of commercial products. Facility 3 had used a new blanket wash for health, safety, or environmental reasons on one occasion prior to the performance demonstration, but the wash had not been adopted because it left an oily residue on the blanket and took too long to dry. Normal blanket washing procedure is the following: a squirt bottle is used to apply blanket wash to a reusable shop towel, the shop towel is then used to wipe the blanket as it is manually rotated, and the blanket is allowed to air dry. Standard facility blanket wash was a mixture of aliphatic and aromatic hydrocarbons, according to the MSDS. The application procedure was not changed for the performance demonstration.

The press operator cleaned four blankets with Wash 10 before declining to conduct a performance demonstration of the product due to its poor performance. Wash 10 did not absorb into the application shop towel, creating safety and cleanliness problems in the pressroom as excess wash dripped on the floor and press. A variety of methods were tried to get the wash to absorb into the standard reusable application shop towel, but none were successful. These methods included cupping the shop towel to keep the blanket wash from running off of the surface immediately, applying the blanket wash to the shop towel on a flat surface and then folding the shop towel over the applied wash, and placing the mouth of the applicator bottle directly onto the surface of shop towel to contain the wash until it had fully absorbed. In addition, Wash 10 did not cut the ink well. According to the press operator, 3-4 times the effort required to use the baseline wash was necessary to remove ink from the blanket with Wash 10 under light ink coverage conditions.

Facility 4

Wash 10 was used on a 4-unit, 34" x 40" press at Facility 4 which does most of its business in commercial printing products such as software manuals and calendars. Facility 4 uses a solution of aliphatic hydrocarbons, aromatic hydrocarbons, and surfactants, according to the MSDS, as the standard blanket wash. Blanket wash procedure at Facility 4 consists of a two wipe process. Blanket wash is applied to a clean, dry, and reusable shop towel which is used to wash the blanket. Another clean dry shop towel is then used to remove excess wash and dry the blanket. If ink buildup on the shop towels is not significant, the shop towels are used to wash more than one blanket. If paper coating is deposited on the blanket from the job, the blanket wash shop towel is dipped into a bucket of water before wiping down the blanket. This standard blanket washing procedure was not modified for the performance demonstration.

The press operator at Facility 4 used Wash 10 to clean four blankets before declining to conduct a performance demonstration of the product due to its poor performance. Under medium ink coverage conditions, Wash 10 did not cut the ink well and required considerably more effort then the standard facility wash or baseline wash of the performance demonstration. An average

of six blanket rotations were necessary to clean the blanket, two times more than were necessary with the baseline and standard washes. In addition, Wash 10 did not soak well into the standard reusable shop towels at Facility 4, creating further delays. A variety of methods were tried to get the wash to absorb into the application shop towel, but none were successful. These methods included cupping the shop towel to keep the blanket wash from immediately running off of the shop towel surface, applying the blanket wash to the shop towel and then folding the shop towel over the applied wash, and placing the mouth of the applicator bottle directly onto the surface of shop towel to contain the wash until it had fully absorbed. The press operator, who had broken into a sweat from the effort required to use Wash 10, declined to use the product for the week-long performance demonstration.

Summary of Performance Demonstrations for Blanket Wash 10

Laboratory Testing Results								
Product	**VOC Content (lbs/gal; % by wt)**	**Flashpoint (°F)**	**pH**	**Vapor Pressure (reported, mm Hg)**	**Blanket Swell (%)**		**Washability (# strokes)**	
					1 hour	***5 hour***	***Wet Ink***	***Dry Ink***
WASH 10	0.16; 2%	230+	5.7	17.5 @ 68°F	0.7	0.7	12	13
Baseline Wash	6.2; 100%	50	6.6	15 @ 100°F	1.5	3	3	8

Field Demonstration Results								
Product/ Facility	**Average Volume Used (ounces)**	**Time required[b] (# rotations)**			**Physical Effort Required (Low, Medium, or High)**			**Performance Evaluation**
		Light Coverage	*Medium Coverage*	*Heavy Coverage*	*Light Coverage*	*Medium Coverage*	*Heavy Coverage*	
WASH 10 at Facility 3	1.0 ± 0.0 (n=4)[a]	2.0 ± 0.0	2.0 ± 0.0	NA	High	High	NA	*Based on a sample size of 4 blanket washes:* • Printer declined to test product due to level of effort required to clean blanket. • Did not absorb well into shop towel. • Did not cut ink well.
Baseline Wash at Facility 3	1.0 (n=1)	NA	1.0 ± 0.0	NA	NA	Medium	NA	• Good performance: cut the ink well. • Slight, unpleasant odor.
WASH 10 at Facility 4	3.0 ± 0.0 (n=4)	NA	6.2 ± 0.5	NA	NA	High	NA	*Based on a sample size of 4 blanket washes:* • Printer declined to test product due to level of effort required to clean blanket. • Did not absorb well into shop towel. • Did not cut ink well.
Baseline Wash at Facility 4	3.0 ± 0.0 (n=2)	NA	3.0 ± 0.0	NA	NA	Low	NA	• Good performance: cut the ink well. • Slight, unpleasant odor.

NA = Not Applicable; product was not demonstrated under these conditions.

[a] n = number of washes on which this data is based, as recorded by the observer.

[b] Time required to clean the blanket measured by the number of blanket rotations. Avg. time per rotation = 30.0 sec. at Facility 3 and 202.5 sec. at Facility 4 (based on time recorded by the project observer)

Blanket Wash 11

Composition:
Fatty acid derivatives
Hydrocarbons, petroleum distillates
Hydrocarbons, aromatic
Alkyl benzene sulfonates

VOC Content: 61%; 4.3 lbs/gal
Flashpoint: 150°F
pH: 5.0 (fluctuates wildly)

Facility 1

At Facility 1, performance demonstrations were conducted on an eight-unit, 28" x 40" press using vegetable-based inks to print high quality, multi-color, commercial products. Currently, Facility 1 uses a blanket wash which, according to the MSDS, consists of aromatic hydrocarbons, 1,2,4-trimethylbenzene, and aliphatic hydrocarbons. In the months preceding the demonstrations, the facility had tried two different low-VOC blanket washes; neither worked as well as their standard wash. At this facility, each blanket is typically wiped down twice during cleaning: once with a reusable shop towel saturated in blanket wash to remove the ink, and once with a dry shop towel to remove excess blanket wash. Each saturated shop towel is used to clean two blankets. The same application procedure was used for the baseline and substitute products. The quantity of wash needed to saturate the shop towel and clean the blanket remained constant throughout the demonstration, regardless of the ink coverage or ink build-up on the blanket. There were both positive and negative aspects to this application method. While more wash than was needed may have been used in some cases, the consistency of the application volume made it possible to compare the performance of the standard, baseline, and substitute products under the same conditions.

In the case of light or medium ink coverage, Wash 11 cut the ink well and the press operator generally considered the performance "good" or "fair." For heavy ink coverage, performance of the product was usually evaluated as "poor." The press operator cleaned all blankets using Wash 11 for three days (26 blankets) until he ran out of the substitute wash. Extra time and effort were needed, however, to remove the oily residue from the blanket when compared to the baseline product. Wiping the blanket with one clean, dry shop towel (as was used with their standard blanket wash and with the baseline wash) did not completely remove the residue; oily streaks of wash remained on the blanket. The press operator was able to remove the residue by wiping the blanket with a clean shop towel that was dampened with water, followed by a clean, dry wipe. This extra step reduced the oily residue, but increased the time and effort required to wash the blanket (from 2 rotations or 40 seconds with the baseline wash to 3 - 4 rotations or 60 - 80 seconds with Wash 11).

In the case of heavy ink coverage, the performance of Wash 11 was considered "poor." The substitute wash, did not cut the ink well in cases of heavy coverage or excessive ink build-up. Since this printer has eight unit press, the ink build-up on the last print unit can be especially heavy. Because of this problem with heavy ink coverage, the printer felt this product was not a suitable substitute for his facility.

The printer found the oily residue had no overall affect on the print quality: while it made the blanket less tacky which *reduced* the time to get back up to acceptable quality, the same residue washed out the color somewhat, which *increased* the sheets required to achieve acceptable print quality.

Facility 2

Facility 2 used a three-unit, 13" x 18" press for the performance demonstrations. This facility prints commercial products (brochures, flyers, cards) using both conventional and vegetable oil-based inks. Their standard wash consists of aromatic hydrocarbons, 1,2,4-trimethylbenzene, and aliphatic hydrocarbons, according to the MSDS. The press operator noted that the standard wash cuts the ink well, but does have somewhat of an odor. In the past, Facility 2 has tried two substitute blanket washes: performance was rated as poor ("it did not work at all") for one product, and the other product they tried was too expensive. In their standard blanket washing procedure, the press operator at this facility pours the blanket wash onto a reusable shop towel from a squirt bottle, wipes the ink off the blanket in one rotation, then uses a dry shop towel for one rotation to remove the excess wash. This application procedure was also used for both the baseline and the substitute washes.

The performance of Wash 11 was considered "good" or "fair" when ink coverage was light or medium. For heavy ink coverage, the wash performance was evaluated as "poor." Facility 2 used Wash 11 for one week , recording information on 31 blanket cleanings. When ink coverage was light or medium, the Wash 11 usually matched the baseline level of performance, which was rated as "good." The baseline wash cut the ink very well; the quantity, effort, and time required were the same as with this facility's standard product. The performance of Wash 11 was comparable to the baseline for light/medium ink coverage requiring an average of two cleaning rotations, two wipes, and approximately one ounce of product to clean the blanket. For heavy ink coverage, however, an average of 8 rotations (ranging from 4 up to 12), 5 wipes, and 4 ounces of Wash 11 were needed to clean the blanket. In addition to the extra time and quantity of product needed, removing the heavy coverage ink required additional physical effort. The overall product performance for removing heavy ink coverage was considered "poor," although Wash 11 ultimately did remove the ink and did not affect print quality.

In all cases, Wash 11 left an oily residue on the blanket which was removed with a dry shop towel. Removing this oily residue did not require any time or effort beyond their standard method where the blanket is wiped with a dry shop towel for one rotation.

Summary of Performance Demonstrations for Blanket Wash 11

Laboratory Testing Results								
Product	**VOC Content (lbs/gal; % by wt)**	**pH**	**Flashpoint (°F)**	**Vapor Pressure (reported, mm Hg)**	**Blanket Swell (%)**		**Washability (# strokes)**	
					1 hour	***5 hour***	***Wet Ink***	***Dry Ink***
WASH 11	4.3; 61%	5.0 (fluctuated during test)	150	0.2 @ 68°F	0	1.5	4	5
Baseline Wash	6.2; 100%	6.6	50	15 @ 100°F	1.5	3	3	8

Field Demonstration Results								
Product/ Facility	**Average Volume Used (ounces)**	**Time required[b] (# rotations)**			**Physical Effort Required (Low, Medium, or High)**			**Performance Evaluation**
		Light Coverage	*Medium Coverage*	*Heavy Coverage*	*Light Coverage*	*Medium Coverage*	*Heavy Coverage*	
WASH 11 at Facility 1	2.5 ± 0.6 (n=26)[a]	3.0 ± 0.0	3.5 ± 0.7	4.0 ± 0.8	Medium	Medium	High	*Based on a sample size of 26 blanket washes:* • Good performance for light/medium ink coverage. • Extra time and effort needed for heavy ink coverage. • Left slight, oily residue on blanket, but it did not affect the print quality.
Baseline Wash at Facility 1	2.5 ± 0.0 (n=2)	2.0 ± 0.0	2.0 ± 0.0	NA	Medium	Medium	NA	• Good performance. • Required slightly more effort than their standard product to remove excess wash.
WASH 11 at Facility 2	1.5 ± 1.5 (n=31)	2.1 ± 0.6	2.0 ± 1.2	8.2 ± 3.5	Medium	Medium	High	*Based on a sample size of 31 blanket washes:* • Good/fair performance for light/medium ink coverage. • Extra time and effort were required for heavy ink coverage. • Left slight, oily residue on blanket, but it did not affect the print quality.
Baseline Wash at Facility 2	1.2 ± 0.8 (n=3)	2.7 ± 1.1	NA	NA	Medium	NA	NA	• Good performance • Cut ink as well as their standard wash.

NA = Not Applicable; product was not demonstrated under these conditions.

[a] n = number of washes on which this data is based, as recorded by the printer.

[b] Time required to clean the blanket measured by the number of blanket rotations: Avg. time per rotation = 23.2 sec. at Facility 1 and 10.0 sec. at Facility 2 (based on time recorded by the observer)

Blanket Wash 12

Composition:
Hydrocarbons, petroleum distillates
Water

VOC Content: 20%; 1.3 lbs/gal
Flashpoint: 125°F
pH: 8.2

Facility 12

At Facility 12, Wash 12 was used on a 6-unit, 28" x 40" press with conventional inks. A variety of commercial products on a variety of paper types were printed during the performance demonstration: from posters on glossy stock to information cards on cardboard stock. Wash 12 was used approximately thirty times during the week-long performance demonstration. In the typical blanket washing procedure at Facility 12, each blanket is wiped twice: once with a reusable shop towel saturated with blanket wash from a plunger can, and once with a dry reusable shop towel to remove the excess blanket wash. The blanket wash shop towel is often used on more than one blanket, depending on the cleanliness of the shop towel as well as the ink coverage. The standard facility wash is a petroleum naphtha-based product, according to the MSDS. In the performance demonstration, the only change in application procedure was that Wash 12 was directly applied to each shop towel for the application process and the plunger can was not used. Wash 12 was diluted 50% with water at Facility 12.

Wash 12 was considered approximately equal to the baseline wash in overall performance; both received fair ratings on the good-fair-poor scale. According to press operators, Wash 12 required less effort than the baseline wash, but more time to complete the wash procedure. The number of rotations increased from an average of 3.0 for the baseline wash to 4.6 for Wash 12, approximately equal to a time increase of one and a half minutes per blanket at this facility. Wash 12 cut the ink satisfactorily, but not well, at all ink coverages, and did a poor job of cutting through paper residue on the blankets. On print runs that coated the blanket with paper residue, 12 rotations were necessary to clean the blanket, while only 4 rotations were needed for print runs without paper residue. Use of Wash 12 was discontinued on paper residue coated blankets due to this increased time requirement. The problem with paper residue was not related to ink coverage; the major increase in number of rotations occurred on a light coverage job. Some inconsistencies also arose with print quality. In some cases, after the blanket was cleaned, the color came back faster than with the baseline and regular washes (10 impressions instead of 20). At other times, however, Wash 12 may have caused dull spots to appear on the printed image.

Facility 13

Facility 13 used Wash 12 on a 2-unit, 20" x 26" press during the performance demonstration. Performance demonstration print jobs were primarily folders and brochures printed with light conventional ink coverage on glossy enamel paper. The blanket washing procedure at this facility involves two disposable paper shop towels: one is saturated with blanket wash from a squirt bottle and used to clean the blanket; the other is used dry to remove excess wash and dry the blanket. During this process, the blanket is rotated incrementally under manual control. The standard application method was not changed for the performance demonstrations.

Wash 12 was used for two one week trial periods in order to experiment with a variety of dilution ratios, ranging from 50% to 0% water. Averaged over all dilution ratios, Wash 12 required

slightly less effort than the baseline wash, but was only considered a fair performer overall by the press operator. The time required to wash the blanket (as measured by number of rotations) was equal for the baseline wash and Wash 12 when averaged across dilution levels. However, as the ratio of blanket wash to water increased, the performance of Wash 12 improved. A 50% mixture of blanket wash and water left the blanket "wet" and solicited a poor performance rating from the press operator under all ink coverages. When the percentage of water was decreased to 25% of the overall mixture, the wash performance was generally rated as fair to good across all print ink coverages. The undiluted blanket wash performed the best. The press operator conducting the trials commented that the undiluted blanket wash performed better than the baseline wash and even surpassed the performance of the standard facility blanket wash in all categories. The undiluted wash received good performance and low effort ratings every time it was used. Product instructions, however, indicate that the blanket wash should be mixed from 1:1 to 1:8 with water. The press operator commented that the blanket wash odor was faint at all dilution levels, but was not disagreeable.

Summary of Performance Demonstrations for Blanket Wash 12

Laboratory Testing Results								
Product	**VOC Content (lbs/gal; % by wt)**	**Flashpoint (°F)**	**pH**	**Vapor Pressure (reported, mm Hg)**	**Blanket Swell (%)**		**Washability (# strokes)**	
					1 hour	***5 hour***	***Wet Ink***	***Dry Ink***
WASH 12	1.3; 20%	125	8.2	0.7 @ 68°F	0	1.5	7	11
Baseline Wash	6.2; 100%	50	6.6	15 @ 100°F	1.5	3	3	8

Field Demonstration Results								
Product/ Facility	**Average Volume Used (ounces)**	**Time required[b] (# rotations)**			**Physical Effort Required (Low, Medium, or High)**			**Performance Evaluation**
		Light Coverage	*Medium Coverage*	*Heavy Coverage*	*Light Coverage*	*Medium Coverage*	*Heavy Coverage*	
WASH 12 at Facility 12	5.4 ± 0.8 (n=16)[a]	12.0 ± 0.0	4.0 ± 0.6	4.5 ± 0.6	High	Medium	Medium	*Based on a sample size of 16 blanket washes:* • Caused potential print quality problems. • Was considered equal to baseline wash in overall performance. • Had difficulty cutting paper residue. • Wash was diluted 50% with water.
Baseline Wash at Facility 12	4.4 ± 1.6 (n=6)	4.0 ± 0.0	2.5 ± 1.0	NA	High	High	NA	• Required greater effort than standard wash. • Did not cut ink as well as standard wash.
WASH 12 at Facility 13	1.8 ± 0.4 (n=19)	1.0 ± 0.0	1.0 ± 0.0	1.0 ± 0.0	Medium	Medium	Medium	*Based on a sample size of 19 blanket washes:* • When not diluted with water, performance surpassed baseline and standard washes. • At most dilution levels, required slightly less effort than baseline wash. • Overall fair performance rating across ink coverages and dilutions.
Baseline Wash at Facility 13	2.1 ± 0.5 (n=4)	1.0 ± 0.0	1.0 ± 0.0	NA	Medium	High	NA	• Good performance, cut the ink well. • Removed ink in one rotation.

NA = Not Applicable; product was not demonstrated under these conditions.

[a] n = number of washes on which this data is based, as recorded by the printer.

[b] Time required to clean the blanket measured by the number of blanket rotations: Avg. time per rotation = 48.0 sec. at Facility 12 and 62.5 sec. at Facility 13

Blanket Wash 14

Composition:
Fatty acid derivatives
Propylene glycol ethers
Water

VOC Content: 12%; 0.97 lbs/gal
Flashpoint: 230+°F
pH: 5.0

Facility 6

At Facility 6, Wash 14 was used on a single-unit, 18" x 24" press and a single-unit 18" x 25" press with conventional inks to print credit cards, identification cards and other products on plastic substrates. The press operator cleaned all blankets using Wash 14 for the week-long demonstration. At this facility, each blanket is typically wiped down four times during cleaning: three times to remove the ink with reusable shop towels soaked with blanket wash; and once with a shop towel soaked with a more volatile wash to dry the blanket. Currently, this facility cleans their blankets using a wash which contains aliphatic petroleum distillates, aromatic petroleum distillates, 1,2,4-trimethylbenzene, nonylphenoxypoly (ethyleneoxy) ethanol, diisononyl phthalate, and 2,6,-di-tert-butyl-p-cresol, according to the MSDS. The blanket wash is applied to the shop towel using a squirt bottle and the shop towel is resoaked with wash prior to reuse on other blankets. The same shop towels are used until there is too much ink buildup on the shop towel to effectively clean the blanket. During this procedure, the blanket turns automatically at a constant rate. This application procedure was modified for the substitute product demonstration by replacing the Tru-dot cleaner used in the last step with a dry shop towel to dry the blanket.

Overall, the performance of Wash 40 was considered "good" on all ink coverages, although it required almost twice as many rotations (eight rotations) to clean a blanket with heavy ink coverage than to clean a blanket with medium ink coverage. The press operator found that Wash 14 cut the ink well; with about the same effectiveness as the baseline wash which the operator also found to cut the ink well. Some additional time and effort were needed to remove a slight oily residue left by the substitute wash using a clean dry shop towel. The average time required to rotate a blanket was measured to be 22.5 seconds, therefore it required an extra 1.5 minutes to clean the blanket with heavy ink coverage. The amount of extra effort required, however, was considered to be a "medium" amount for light and medium ink coverages and "high" when cleaning a blanket with a heavy ink coverage. The quantity of substitute wash used was slightly lower than the quantity of baseline wash used. At all levels of ink coverage, no print quality problems attributable to Wash 14 were experienced. The press operator also noticed that Wash 14 did not have a strong solvent smell as opposed to the facility's standard wash or the baseline wash.

Facility 16

Facility 16 used a 2-unit 20" x 26" press with conventional inks to print advertisements, cards, and other commercial products. The press operator at Facility 16 used Wash 14 for all jobs during the one-week demonstration. At this facility, each blanket is typically wiped down three times during cleaning: once with a wet sponge to remove paper dust (when needed); once with a reusable shop towel soaked with naphtha (which is also the baseline wash used throughout the demonstrations); and finally with a clean dry shop towel to remove excess wash. This application procedure was also used for the application of the substitute wash. Facility 16 has tried substitute, low-VOC blanket washes in the past, but found that the products were not acceptable because they did not dry on the blanket as fast as their standard wash.

Overall, at Facility 16 the performance of Wash 14 was considered "fair". The press operator found that Wash 14 did not cut ink as well as the baseline wash, especially on black inks and in cases of heavy ink build up. Wash 14 was tested under light and medium ink coverage conditions while the baseline wash was observed only under heavy ink coverage conditions. Because the baseline wash is normally used at the facility, the operator's familiarity with the baseline wash allowed him to make accurate comparisons between the substitute wash and the baseline wash under all ink coverage conditions. The substitute wash required more time and effort to clean the blanket than the baseline wash because additional rotations were required to remove the ink. The substitute wash typically required one extra blanket rotation with a blanket wash soaked shop towel. On average, this press operator required 20.8 seconds per blanket rotation, so the actual time to clean a blanket using Wash 14 was not increased significantly. The press operator found that a larger volume of Wash 14 was also needed to remove the ink in comparison to the baseline wash (2.0 ounces for the baseline wash compared to 2.8 ounces for the substitute wash). The overall time and effort to clean the blankets was also a factor of the thick consistency of the substitute wash which made it difficult for the operator to get the product to soak into the shop towel.

Summary of Performance Demonstrations for Blanket Wash 14

Laboratory Testing Results								
Product	**VOC Content (lbs/gal; % by wt)**	**Flashpoint (°F)**	**pH**	**Vapor Pressure (reported, mm Hg)**	**Blanket Swell (%)**		**Washability (# strokes)**	
					1 hour	***5 hour***	***Wet Ink***	***Dry Ink***
WASH 14	0.97; 12%	230+	5	17.5 @ 68°F	1.5	3	8	10
Baseline Wash	6.2; 100%	50	6.6	15 @ 100°F	1.5	3	3	8

Field Demonstration Results								
Product/ Facility	**Average Volume Used (ounces)**	**Time required[b] (# rotations)**			**Physical Effort Required (Low, Medium, or High)**			**Performance Evaluation**
		Light Coverage	*Medium Coverage*	*Heavy Coverage*	*Light Coverage*	*Medium Coverage*	*Heavy Coverage*	
WASH 14 at Facility 6	1.3 ± 0.6 (n=15)[a]	4.3 ± 0.6	4.4 ± 0.5	8.0 ± 0.0	Medium	Medium	High	*Based on a sample size of 15 blanket washes:* • Good performance; cut ink well. • Extra effort was required to remove the oily residue that the wash left on the blanket.
Baseline Wash at Facility 6	1.5 (n=1)	NA	2.0 ± 0.0	NA	NA	Low	NA	• Good performance; cut ink well.
WASH 14 at Facility 16	2.8 ± 0.5 (n=34)	3.2 ± 0.6	4.0 ± 0.5	NA	High	High	NA	*Based on a sample size of 34 blanket washes:* • Did not cut ink as well as the baseline wash. • Black inks and heavy ink build up are especially difficult to clean. • Thick consistency of the wash made it difficult to soak into shop towel.
Baseline Wash at Facility 16	2.0 ± 0.0 (n=3)	NA	NA	3.0 ± 0.0	NA	NA	Low	• Baseline wash is facility's standard wash.

NA = Not Applicable; product was not demonstrated under these conditions.

[a] n = number of washes on which this data is based, as recorded by the printer.

[b] Time required to clean the blanket measured by the number of blanket rotations: Avg. time per rotation = 22.5 sec. at Facility 6 and 20.8 sec. at Facility 16 (based on time recorded by the project observer)

Blanket Wash 19

Composition:
Fatty acid derivatives
Propylene glycol ethers
Water

VOC Content: 22%; 1.8 lbs/gal
Flashpoint: 230+°F
pH: 4.6

Facility 18

At Facility 18, Wash 19 was used on a single-unit 20" x 30" press and a 2-unit, 19" x 26" press with soy oil-based inks. Commercial products such as business forms and brochures were printed. The press operator used Wash 19 for the four days that the presses were operating during the one-week demonstration period which resulted in only five blanket cleanings. At this facility, each blanket is typically wiped down three times during cleaning: twice with a reusable rag soaked with blanket wash, and once with a dry rag to remove excess blanket wash. Blanket wash is applied to the rag using a squirt bottle and the rag is resoaked with wash prior to reuse on other blankets. The same rag is used until it has too much ink build-up to effectively clean the blanket. Currently, this facility cleans their blankets using a wash which contains aliphatic hydrocarbons, according to the MSDS. Other than changing the number of rotations to clean a blanket, this application procedure was not modified during the demonstration of the substitute product. Facility 18 had tried an alternative low-VOC blanket wash, but found that it did not dry as fast as their standard product and was more expensive.

Based on the five blanket cleanings with Wash 19, the press operator at Facility 18 evaluated its performance as "poor". The press operator found that Wash 19 cut ink sufficiently only when applied to the blanket generously. The baseline wash was found to cut the ink well, but required additional effort due to the wash's high resistance to the blanket surface. On average, more than three times as much of Wash 19 was used compared to the baseline wash. The thick consistency of the substitute wash also contributed to the larger quantity of wash needed, as well as increased time and effort to clean a blanket in comparison to the baseline wash. The press operator had difficulty getting the product to soak into the rag, which resulted in a large amount of wash being applied to the blanket on the first few swipes of the rag and a comparatively small amount near the end of the blanket rotation. The press operator would then need to rotate the blanket additional times, applying more substitute wash to ensure that the necessary amount of blanket wash reached all areas of the blanket. This significantly increased the average number of rotations required to clean a blanket, especially in the case of light ink coverage where rotations increased from 2.7 rotations for the baseline wash to 8.0 rotations for the substitute. Because the average time to rotate a blanket was 16.2 seconds at Facility 18, the average blanket cleaning time increased by 1.4 minutes over the baseline wash for light ink coverage. The effort needed to use Wash 19 was evaluated as "high" due to its thick consistency and the extra rotations it required. The press operator observed that the wash cut the ink better on the first few swipes where the wash on the blanket was relatively thick in comparison to other areas with a thinner layer of wash. The press operator also noticed that the ability of the substitute wash to remove ink was better when it was allowed to sit on the blanket for a few minutes before being removed.

Facility 19

Facility 19 used a 2-unit 19" x 26" press also with soy oil-based inks to print brochures, cards, and other commercial products. The press operator at Facility 19 used Wash 19 for three days and then stopped because he found that the product required a significant amount of extra effort, time and quantity of wash to clean the blankets. The operator typically cleans the blanket by pouring the blanket wash onto a clean, reusable rag and wiping the blanket while rotating it manually twice. The blanket is then allowed to dry by evaporation before restarting the press. This application procedure was also used for the application of the baseline wash. When using Wash 19, the press operator modified the application procedure slightly and wiped the blanket with a dry rag before resuming the print job. The standard wash used at this facility contains aromatic hydrocarbons, polyglycol ethers, aliphatic hydrocarbons, and a proprietary combustible chemical, according to the MSDS. Prior to this project, they did some experimenting with another substitute wash, but it did not work as well as their standard product and it was irritating to the skin as well. In the past, they used an automatic blanket washer, hoping to reduce their blanket wash chemical use and labor, but they discontinued using it after they found it required more effort and wasted solvent.

The press operator at Facility 19 evaluated the performance of Wash 19 as "poor". The operator felt that the substitute product did not cut ink as well as the baseline wash. The baseline wash was found to cut the ink well, but required additional effort due to its high resistance to the blanket surface. Some additional time was required to remove the ink using Wash 19 than was required with the baseline wash. In addition, the thick consistency of Wash 19 was found to require extra time, effort and quantity to clean the blankets. The press operator had difficulty getting the product to soak into the rag which resulted in spillage and a "messy" application. When the usual application procedure was used with the Wash 19, an oily residue remained on the blanket which increased the number of copies required to get up to print quality after restarting the press. One or two rotations with a dry rag were needed to remove the residue from the blanket before printing. The quantity of Wash 19 needed to remove the ink more than doubled in comparison to the baseline wash. The press operator rated the effort needed as "high" for both the baseline and the substitute washes. Although the performance of the baseline wash was considered to be good, the effort needed to use the baseline wash was rated as "high" because the operator found it to have high resistance to being dragged across the blanket. The effort to use the substitute wash was rated as "high" due to the extra rotations and the messy application.

Summary of Performance Demonstrations for Blanket Wash 19

Laboratory Testing Results								
Product	**VOC Content (lbs/gal; % by wt)**	**Flashpoint (°F)**	**pH**	**Vapor Pressure (reported, mm Hg)**	**Blanket Swell (%)**		**Washability (# strokes)**	
					1 hour	***5 hour***	***Wet Ink***	***Dry Ink***
WASH 19	1.8; 22%	230+	4.6	17.5 @ 68°F	1.5	1.5	11	9
Baseline Wash	6.2; 100%	50	6.6	15 @ 100°F	1.5	3.0	3	8

Field Demonstration Results								
Product/ Facility	**Average Volume Used (ounces)**	**Time required[b] (# rotations)**			**Physical Effort Required (Low, Medium, or High)**			**Performance Evaluation**
		Light Coverage	*Medium Coverage*	*Heavy Coverage*	*Light Coverage*	*Medium Coverage*	*Heavy Coverage*	
WASH 19 at Facility 18	4.8 ± 3.0 (n=5)[a]	8.0 ± 0.0	7.7 ± 2.1	NA	High	High	NA	*Based on a sample size of 5 blanket washes:* • Thick consistency of wash made it difficult to soak into rag and resulted in uneven application. • Large quantities were required to cut ink.
Baseline Wash at Facility 18	1.5 ± 0.8 (n=6)	2.7 ± 0.5	3.5 ± 0.7	NA	Low	Low	NA	• Good performance; cut the ink well.
WASH 19 at Facility 19	2.2 ± 0.5 (n=8)	4.0 ± 0.0	4.0 ± 0.0	4.0 ± 0.0	High	High	High	*Based on a sample size of 8 blanket washes:* • Thick consistency of wash was messy and difficult to use. • Cut demonstration short due to extra effort and time required to clean blanket.
Baseline Wash at Facility 19	0.9 ± 0.2 (n=5)	2.2 ± 0.4	NA	NA	High	NA	NA	• Good performance; cut the ink well. • Required additional effort to drag across the blanket.

NA = Not Applicable; product was not demonstrated under these conditions.

[a] n = number of washes on which this data is based, as recorded by the printer.

[b] Time required to clean the blanket measured by the number of blanket rotations: Avg. time per rotation = 16.2 sec. at Facility 18 and 18.5 sec. at Facility 19 (based on time recorded by the project observer)

Blanket Wash 20

Composition:
Water
Hydrocarbons, petroleum distillates
Hydrocarbons, aromatic
Alkyl benzene sulfonates

VOC Content: 35%; 2.7 lbs/gal
Flashpoint: 170°F
pH: 7.1

Facility 11

Wash 20 was tested on a 5-unit, 19" x 26" press at Facility 11. During the performance demonstration, conventional and vegetable-based inks were used to produce commercial products such as brochures, publications, and mailings. Facility 11 had tried using alternative blanket washes for worker health and safety or environmental reasons on four occasions prior to the performance demonstration, but use of all four products had been discontinued due to odor problems. Currently, this facility's standard wash consists of petroleum naphtha, dipropylene glycol methyl ether, and 1,8(9)-nenthadiene, according to the MSDS. Normal blanket wash procedure consists of three wipes with a reusable shop towel saturated with blanket wash, followed by a single wipe with a clean dry shop towel to remove excess wash and dry the blanket. The blanket wash is applied to the shop towel with a squirt bottle. If possible, the shop towels were used to clean more than one blanket. This standard application method was also used for the performance demonstration.

Overall, Wash 20 was given a fair performance rating and a medium effort rating. On average, the baseline wash performed better overall, but also required a medium amount of effort. The time required to wash the blanket was slightly less for Wash 20 than for the baseline wash; Wash 20 required 2.8 rotations whereas the baseline wash required 3.5 rotations. However, delays resulted from an oily film sometimes left on the blanket after use of Wash 20. This film had to be removed with a third rotation, thus bringing the average number of rotations close to 3.0 for the performance demonstration. Additional delays resulted from the thick consistency of Wash 20. The press operator often had to wait for the wash to soak into the application shop towel. Greater effort was required to cut ink under heavy ink coverage situations; the press operator gave a greater proportion of high effort ratings to the wash under these conditions. Wash 20 also had difficulty cutting through light inks such as reds and yellows. Press operators did not consider the odor of Wash 20 to be significant.

Facility 12

At Facility 12, Wash 20 was used on a 6-unit, 28" x 40" press with conventional inks. A variety of commercial products on a variety of paper types were printed during the performance demonstration: from posters on glossy stock to information cards on cardboard stock. Wash 20 was used approximately thirty times during the week-long performance demonstration. In the typical blanket washing procedure at Facility 12, each blanket is wiped twice: once with a reusable shop towel saturated with blanket wash from a plunger can, and once with a dry reusable shop towel to remove the excess blanket wash. The blanket wash shop towel is often used on more than one blanket, depending on the cleanliness of the shop towel as well as the ink coverage. According to the MSDS, the standard facility wash is a petroleum naphtha-based product. In the performance demonstration, the only change in application procedure was that Wash 20 was

directly applied to each shop towel for the application process and the plunger can was not used.

Press operators at Facility 12 declined to use Wash 20 after experiencing nausea and dizziness after three trials. Wash 20 aggravated a previously existing respiratory condition in one press operator, and caused dizziness in another. These health problems coincided with a strong odor as blanket wash evaporated from the wash shop towel during the wipe process.

Summary of Performance Demonstrations for Blanket Wash 20

Laboratory Testing Results								
Product	**VOC Content (lbs/gal; % by wt)**	**Flashpoint (°F)**	**pH**	**Vapor Pressure (reported, mm Hg)**	**Blanket Swell (%)**		**Washability (# strokes)**	
					1 hour	***5 hour***	***Wet Ink***	***Dry Ink***
WASH 20	2.7; 35%	170	7.1	1.5 @ 77°F	0	1.5	5	7
Baseline Wash	6.2; 100%	50	6.6	15 @ 100°F	1.5	3	3	8

Field Demonstration Results								
Product/ Facility	**Average Volume Used (ounces)**	**Time required[c] (# rotations)**			**Physical Effort Required (Low, Medium, or High)**			**Performance Evaluation**
		Light Coverage	*Medium Coverage*	*Heavy Coverage*	*Light Coverage*	*Medium Coverage*	*Heavy Coverage*	
WASH 20 at Facility 11	1.4 ± 0.6 (n=17)[a]	2.0 ± 0.0	2.7 ± 0.8	4.0 ± 0.8	Medium	Medium	High	*Based on a sample size of 17 blanket washes:* • Performance considered fair, but worse than facility and baseline washes. • Left oily residue on blanket that required additional rotations to remove. • Hard to apply to shop towels due to thick consistency.
Baseline Wash at Facility 11	0.7 ± 0.2 (n=4)	3.7 ± 0.6	3.0 ± 0.0	NA	Medium	Medium	NA	• Good performance. • Slight odor.
WASH 20 at Facility 12	3.0 (n=1)[b]	NA	5.0 ± 0.0	NA	NA	High	NA	*Based on a sample size of 1 blanket wash:* • Product induced nausea in press operators; Facility declined opportunity to test product.
Baseline Wash at Facility 12	4.4 ± 1.6 (n=6)	4.0 ± 0.0	2.5 ± 1.0	NA	High	High	NA	• Required higher effort than standard wash. • Did not cut ink as well as standard wash. • Slight odor.

NA = Not Applicable; product was not demonstrated under these conditions.

[a] n = number of washes on which this data is based, as recorded by the printer.

[b] n = number of washes this data is based on, as recorded by the observer.

[c c] Time required to clean the blanket measured by the number of blanket rotations. Avg. time per rotation = 95.7 sec. at Facility 11 and 120.0 sec. at Facility 12 (based on time recorded by the project observer)

Blanket Wash 21

Composition:
Hydrocarbons, aromatic
Hydrocarbons, petroleum distillates
Fatty acid derivatives

VOC Content: 47%; 3.5 lbs/gal
Flashpoint: 115°F
pH: 6.2

Facility 6

Facility 6 prints credit cards and identification cards on plastic sheets using conventional inks. Wash 1 was used on a single-unit, 18" x 25" press. Currently, this facility cleans their blankets using a wash which consists of aliphatic petroleum distillates, aromatic petroleum distillates, 1,2,4-trimethylbenzene, nonylphenoxypoly (ethyleneoxy) ethanol, diisononyl phthalate, 2,6,-di-tert-butyl-p-cresol, according to the MSDS. Each blanket is typically wiped down four times during cleaning: three times to remove the ink with reusable shop towels soaked with blanket wash, and once with a shop towel soaked with Tru-dot cleaner (a more volatile wash) to thoroughly dry the blanket. Blanket wash is applied to the shop towel using a squirt bottle and the last shop towel from the previous wash is used as the first shop towel on the next wash. The same shop towels are used until there is too much ink build-up on the shop towel to effectively remove ink. The application procedure was modified slightly for both the baseline wash and the substitute wash during the performance demonstration; a dry shop towel was used to dry the blanket rather than a drying solution.

The operator rated the performance of Wash 21 as "fair" for all levels of ink coverage. It cut the ink well, but it left an oily residue even after wiping the blanket with a dry shop towel. To remove the residue, the press operator wiped the blanket a second time with another dry shop towel. Even with the extra wiping, the operator felt the residue caused color wash-out on the next job, so that additional waste sheets (approximately 50 percent more) were needed to get back to color. After cleaning six blankets with Wash 21, the press operator switched back to using the standard wash. The operator summarized the product performance as fair: it cut the ink well, but the oily residue resulted in extra effort (to dry the blanket) and extra waste sheets (needed to get the press to color). The operator noticed Wash 21 had an odor, but he felt it was much better than the unpleasant odor of his standard wash.

Performance of the baseline product was considered good; it cut the ink well with minimal effort. Compared to Wash 21, the baseline required less effort and time to clean a blanket with medium ink coverage (2 rotations or approximately 41 seconds for the baseline compared to an average of 3.3 rotations or 61 seconds for Wash 21).

Facility 17

At Facility 17, performance demonstrations were conducted on a two-unit, 19" x 26" press with conventional inks where commercial products such as advertisements and brochures were printed. Currently, this facility uses which contains petroleum naphtha, dichloromethane, and 1,1,1-trichloroethane, according to the product's MSDS. This performance demonstration was their first experience in experimenting with substitute blanket washes. Typically the press operator cleans the blanket by pouring the wash from a squirt bottle onto a reusable shop towel

and wiping down the blanket. The wash is allowed to dry by evaporation. Occasionally the operator will mix the wash with water to remove paper dust and paper lines from the blanket.

The overall performance of Wash 21 was rated as "fair;" it cut the ink well, but it left an oily residue on the blanket. Facility 17 used the substitute wash for one week during which 25 washes were recorded by the press operator. Wash 21 cut the ink well, but it was necessary to modify the application procedure slightly and add a drying step to remove the oily residue left on the blanket after applying the wash. Although this step was not required with the facility's standard wash, the operator did not view it as particularly burdensome; level of effort was rated as "low" or "medium." Both Wash 21 and the baseline wash were only used on blankets with light or medium ink coverage; no heavy coverage jobs were run during the demonstration period. The baseline wash cut the ink well with the same level of effort as is required for the facility's standard blanket wash. Compared to the baseline wash, Wash 21 took slightly more time because of the extra drying step.

In addition to the extra effort, the printer noted that the oily residue occasionally caused problems with subsequent print jobs. In two cases, the printer noticed the prints were mottled (fuzzy edges). The printer had to run additional waste sheets to get acceptable, clear print quality. The press operator also commented that the wash did not absorb into the shop towel easily, making it messy to apply. Absorbency was improved somewhat when the wash was applied to a shop towel wet with water.

Summary of Performance Demonstrations for Blanket Wash 21

Laboratory Testing Results								
Product	**VOC Content (lbs/gal; % by wt)**	**pH**	**Flashpoint (°F)**	**Vapor Pressure (reported, mm Hg)**	**Blanket Swell (%)**		**Washability (# strokes)**	
					1 hour	***5 hour***	***Wet Ink***	***Dry Ink***
WASH 21	3.5; 47%	6.2	115	< 0.1 @ 68°F	0	1.5	7	6
Baseline Wash	6.2; 100%	6.6	50	15 @ 100°F	1.5	3	3	8

Field Demonstration Results								
Product/ Facility	**Average Volume Used (ounces)**	**Time required[b] (# rotations)**			**Physical Effort Required (Low, Medium, or High)**			**Performance Evaluation**
		Light Coverage	*Medium Coverage*	*Heavy Coverage*	*Light Coverage*	*Medium Coverage*	*Heavy Coverage*	
WASH 21 at Facility 6	2.0 ± 0.6 (n=6)[a]	2.0 ± 0.0	3.3 ± 0.6	4.0 ± 0.0	Low	Medium	High	*Based on a sample size of 6 blanket washes:* • Fair performance. • Cut ink well, but oily residue was difficult to remove. • Extra waste sheets required to get back up to color because of residue.
Baseline Wash at Facility 6	1.5 (n=1)	NA	2	NA	NA	Low	NA	• Good performance. • Cut the ink well without extra effort.
WASH 21 at Facility 17	1.6 ± 0.4 (n=25)	1.8 ± 0.4	2.1 ± 0.4	NA	Low	Medium	NA	*Based on a sample size of 25 blanket washes:* • Fair performance • Oily residue caused print problems if it was not completely removed. • Wash did not absorb into shop towel easily.
Baseline Wash at Facility 17	1.5 ± 0.4 (n=5)	1.3 ± 0.5	1.0 ± 0.0	NA	Medium	Medium	NA	• Good performance • Same effort as standard wash required.

NA = Not Applicable; product was not demonstrated under these conditions.

[a] n = number of washes on which this data is based, as recorded by the printer.

[b] Time required to clean the blanket measured by the number of blanket rotations: Avg. time per rotation = 20.5 sec. at Facility 6 and 17.1 sec. at Facility 17 (based on time recorded by the observer)

Blanket Wash 22

Composition:
Fatty acids derivatives
Hydrocarbons,aromatic
Water

VOC Content: Not measured
Flashpoint: 157°F (full strength)
pH: 7.4 (25%)

Facility 12

At Facility 12, Wash 22 was used on a 6-unit, 28" x 40" press with conventional inks. A variety of commercial products on a variety of paper types were printed during the performance demonstration: from posters on glossy stock to information cards on cardboard stock. Wash 12 was used approximately thirty times during the week-long performance demonstration. In the typical blanket washing procedure at Facility 12, each blanket is wiped twice: once with a reusable shop towel saturated with blanket wash from a plunger can, and once with a dry reusable shop towel to remove the excess blanket wash. The blanket wash shop towel is often used on more than one blanket, depending on the cleanliness of the shop towel as well as the ink coverage. The standard facility wash is a petroleum naphtha-based product, according to the MSDS. In the performance demonstration, the only change in application procedure was that Wash 22 was directly applied to each shop towel for the application process and the plunger can was not used.

Overall, the performance of Wash 22 was rated as fair. According to press operators, Wash 22 cut the ink well and performed better than the baseline wash overall, but it's thick consistency caused delays while the press operator waited for the wash to soak into the application shop towel. During the initial observation period, the press operator showed great enthusiasm for Wash 22, rating overall performance as good as the standard facility wash and better than the baseline wash in all trials. Over the course of the week, however, the time delays associated with wash application began to weaken the press operator approval for Wash 22. The difficulty in saturating the wash shop towel may have been due to the squirt bottle application device used in the performance demonstration. The use of a plunger might have decreased the wash application time.

At Facility 12, Wash 22 removed the ink with low or medium effort on all ink coverages and, on average, outperformed the baseline wash. The number of rotations required to wash the blanket (proportional to the amount of time) did not increase dramatically from one ink coverage to another. Wash 22 did not leave streaks or residue on the blanket after wiping with a dry shop towel in the standard procedure. There was no change in print quality attributed to the wash. The wash did not perform as well with metallic inks as it did with conventional inks, however. When used on metallic inks, both the effort required to wash the blanket and the amount of wash required increased.

Facility 13

Facility 13 used Wash 22 on a 2-unit, 20" x 26" press during the performance demonstration. Performance demonstration print jobs were primarily folders and brochures printed with light conventional ink coverage on glossy enamel paper. The blanket washing procedure at this facility involves two disposable paper shop towels: one is saturated with blanket wash from a squirt bottle and used to clean the blanket; the other is used dry to remove excess wash and dry the blanket. During this process, the blanket is rotated incrementally under manual

control. The standard application method was not changed for the performance demonstrations.

Overall, press operators rated Wash 22 as a fair performer on the good-fair-poor scale. The baseline and standard washes cut the ink well and were given good performance ratings. Wash 22 cut the ink as well as the baseline and standard washes, but its thick consistency caused delays at the wash application and drying stages. At the blanket wash application stage, the viscous Wash 22 required extra time to soak into the application shop towel before blanket cleaning could begin. After blanket cleaning, Wash 22 left the blanket slightly streaked and wet. Press operators recognized that extra time was necessary to allow excess wash to evaporate and to avoid potential print quality problems. As an indication of this, the number of rotations needed to clean the blanket (considered proportional to the overall time required to wash the blanket) was four times greater for Wash 22 than with the baseline wash. A contributing factor to both of these delays may have been the type of disposable shop towel used by Facility 13 for blanket washing and other press cleaning activities. These disposable paper shop towels were clearly less absorbent than reusable alternatives. The excess wash remaining on the blanket was allowed to evaporate because the disposable shop towels were not absorbent enough to remove it. Overall, press operators at Facility 13 rated the ink cutting ability of Wash 22 as the same as the baseline and standard washes, but felt that the delays in the wash process resulted in greater overall effort and a fair performance rating.

Summary of Performance Demonstrations for Blanket Wash 22

Laboratory Testing Results								
Product	**VOC Content (lbs/gal; % by wt)**	**Flashpoint (°F)**	**pH**	**Vapor Pressure (reported, mm Hg)**	**Blanket Swell (%)**		**Washability (# strokes)**	
					1 hour	***5 hour***	***Wet Ink***	***Dry Ink***
WASH 22	Not measurable; 2.17%[a]	157	7.4[b]	<1 @ 68°F	1.5	1.5	13	13
Baseline Wash	6.2; 100%	50	6.6	15 @ 100°F	1.5	3	3	8

Field Demonstration Results								
Product/ Facility	**Average Volume Used (ounces)**	**Time required[d] (# rotations)**			**Physical Effort Required (Low, Medium, or High)**			**Performance Evaluation**
		Light Coverage	*Medium Coverage*	*Heavy Coverage*	*Light Coverage*	*Medium Coverage*	*Heavy Coverage*	
WASH 22 at Facility 12	4.4 ± 0.6 (n=5)[c]	2.7 ± 1.2	3.0 ± 0.0	4.0 ± 0.0	Low	Medium	Medium	*Based on a sample size of 5 blanket washes:* • Cut ink as well as baseline wash. • Did not readily soak into shop towel, creating delays. • Fair performer overall.
Baseline Wash at Facility 12	4.4 ± 1.6 (n=6)	4.0 ± 0.0	2.5 ± 1.0	NA	High	High	NA	• Required slightly higher effort than standard wash. • Good performer.
WASH 22 at Facility 13	3.4 ± 1.7 (n=17)	4.0 ± 0.0	2.5 ± 1.6	NA	Medium	Medium	NA	*Based on a sample size of 17 blanket washes:* • Difficult to apply due to thick consistency. • Left blanket slightly streaked and wet, extra drying time necessary to prevent print quality problems. • A fair performer: cut ink well, but required greater effort than baseline.
Baseline Wash at Facility 13	2.1 ± 0.5 (n=4)	1.0 ± 0.0	1.0 ± 0.0	NA	Medium	High	NA	• Cut ink well, a good performer. • Dried quickly on blanket.

NA = Not Applicable; product was not demonstrated under these conditions.

[a] VOC content in lbs/gal was not measurable; % by weight VOC was reported by manufacturer.

[b] 25%

[c] n = number of washes on which this data is based, as recorded by the printer.

[d] Time required to clean the blanket measured by the number of blanket rotations. Avg. time per rotation = 27.5 sec. at Facility 12 and 105.0 sec. at Facility 13

Blanket Wash 24

Composition:
Terpenes
Ethylene glycol ethers
Ethoxylated nonylphenol
Alkyl benzene sulfonates
Alkali/salts
Water

VOC Content: 19%; 1.5 lbs/gal
Flashpoint: 100°F
pH: 9.9

Facility 16

Facility 16 used a 2-unit 20" x 26" press with conventional inks to print advertisements, cards, and other commercial products. The press operator at Facility 16 used Wash 24 for all jobs during the one-week demonstration, with the exception of one job for which there was a concern that the substitute wash would have an effect on the print quality. At this facility, each blanket is typically wiped down three times during cleaning: once with a wet sponge to remove paper dust (when needed); once with a reusable shop towel soaked with naphtha (which is also the baseline wash used throughout the demonstrations); and finally with a clean dry shop towel to remove excess wash. This application procedure was also used for the application of the substitute wash. Facility 16 has tried substitute, low-VOC blanket washes in the past, but found that the products were not acceptable because they did not dry on the blanket as fast as their standard wash.

Overall, the press operator at facility 16 felt that the performance of Wash 24 was "fair". The wash was found to remove the ink well, but a residue was left on the blanket which had an effect on the print quality. Following the manufacturer's instructions, Wash 24 was initially tried at 50% dilution with water. After washing three blankets with the diluted wash, it was apparent that it was not adequately cutting the ink. The baseline wash was found to cut the ink well, but required additional effort due to its resistance to the blanket surface. At full strength, Wash 24 was found to cut the ink with about the same effectiveness as the baseline wash. Wash 24 was tested under light, medium and heavy ink coverage conditions while the baseline wash was observed only under heavy ink coverage conditions. Because the baseline wash is normally used at the facility, the operator's familiarity with the baseline wash allowed him to make accurate comparisons between the substitute wash and the baseline wash under all ink coverage conditions. Under heavy ink coverage conditions, Wash 24 was observed to match the baseline level of performance as measured by blanket rotations. Under light and medium ink coverage conditions, however, Wash 24 was found to require slightly more time than the baseline wash. Overall, the level of effort was rated as "medium" for the substitute wash and "low" for the baseline wash. The press operator considered the effort to be higher than the baseline wash because the substitute wash required extra effort to remove as much of an oily residue as possible and because the thick consistency of the product made it difficult to get it to soak into the shop towel. Most importantly, however, was that this oily residue consistently increased the number of copies needed to return to print quality after restarting the press. Some of this residue would remain on the blanket even after wiping it with a clean dry shop towel.

Facility 17

At Facility 17, Wash 24 was used on a 2-unit, 19" x 26" press with conventional inks to print commercial products such as advertisements and brochures. Facility 17 operates two shifts per day, however, Wash 24 was tested by only one press operator during the first shift. The press operator used Wash 24 for two days and then stopped because he found the amount of effort required to use the substitute wash to be unacceptable. The press operator typically cleans the blankets by going over the blanket once with a shop towel soaked with blanket wash, and then allowing the blanket to dry by evaporation. Occasionally the operator will mix the wash with water to remove paper dust and paper lines from the blanket. Currently, this facility cleans their blankets using a product which consists of petroleum naphtha, dichloromethane and 1,1,1 trichloroethane, according to the MSDS.

Overall, the performance of Wash 24 was considered "poor" by the press operator. Although the product was observed to cut the ink with about the same effectiveness as the baseline wash, it had a thick consistency and left an oily residue, both of which required additional time and effort to clean the blanket. The press operator found the baseline wash to cut the ink well, but some extra effort was required to drag the wash soaked shop towel across the blanket compared to the substitute wash. Wash 24 was demonstrated on blankets with medium ink coverage only. The press operator found that under these conditions the substitute wash required more than twice the number of rotations as the baseline wash, due to the extra steps needed to remove the oily residue using a clean dry shop towel. At this facility, one rotation of the blanket typically took 24.6 seconds, so on average the substitute wash required an extra 37 seconds of cleaning time. Most important to the operator, however, was that the thick consistency of the substitute product made it very difficult to get the product to soak into the shop towel which increased the overall effort to clean the blankets and resulted in significant amounts of wash spilling on the floor and press. The quantity of wash used was about the same for both the substitute wash and the baseline wash. In addition, the press operator was bothered by the strong citrus odor of Wash 24.

Summary of Performance Demonstrations for Blanket Wash 24

Laboratory Testing Results								
Product	**VOC Content (lbs/gal; % by wt)**	**Flashpoint (°F)**	**pH**	**Vapor Pressure (reported, mm Hg)**	**Blanket Swell (%)**		**Washability (# strokes)**	
					1 hour	***5 hour***	***Wet Ink***	***Dry Ink***
WASH 24	1.5; 19%	100	9.9	<1 @ 25°F	1.5	3.0	15	12
Baseline Wash	6.2; 100%	50	6.6	15 @ 100°F	1.5	3.0	3	8

Field Demonstration Results								
Product/ Facility	**Average Volume Used (ounces)**	**Time required[b] (# rotations)**			**Physical Effort Required (Low, Medium, or High)**			**Performance Evaluation**
		Light Coverage	*Medium Coverage*	*Heavy Coverage*	*Light Coverage*	*Medium Coverage*	*Heavy Coverage*	
WASH 24 at Facility 16	2.2 ± 0.6 (n=28)[a]	3.1 ± 1.0	3.0 ± 0.0	3.0 ± 0.0	Medium	Medium	Medium	*Based on a sample size of 28 blanket washes:* • Cut ink well, but some extra effort was required to wipe off oily residue. • Oily residue significantly increased the number of copies required to return to print quality.
Baseline Wash at Facility 16	2.0 ± 0.0 (n=3)	NA	NA	3.0 ± 0.0	NA	NA	Low	• Baseline wash was also the facility's standard wash.
WASH 24 at Facility 17[c]	1.3 ± 0.6 (n=4)	NA	2.5 ± 0.6	NA	NA	High	NA	*Based on a sample size of 4 blanket washes:* • Cut ink well. • Extra effort to wipe off oily residue. • Thick consistency of wash caused operator to curtail use. • Citrus odor was very strong to operator.
Baseline Wash at Facility 17	1.5 ± 0.4 (n=5)	1.3 ± 0.5	1.0 ± 0.0	NA	Medium	Medium	NA	• Good performance; cut ink well. • Extra effort was required due to resistance to drag across blanket.

NA = Not Applicable; product was not demonstrated under these conditions.

[a] n = number of washes on which this data is based, as recorded by the printer. [c]Based on observer's data; printer data not received.

[b] Time required to clean the blanket measured by the number of blanket rotations. Avg. time per rotation = 21.1 sec. at Facility 16 and 24.6 sec. at Facility 17 (based on time recorded by the project observer)

Blanket Wash 26

Composition:
Fatty acids derivatives
Esters/lactones

VOC Content: 18%; 1.3 lbs/gal
Flashpoint: 230+°F
pH: 7.8 (fluctuates wildly)

Facility 5

At Facility 5, Wash 26 was used on a single-unit, 12" x 18" press to print commercial products such as business cards and advertisements with conventional inks. Facility 5 has tried a variety of substitute blanket washes donated by suppliers but has never adopted one due to performance and cost issues. Currently, this facility uses two different blanket washes. According to the product MSDSs, one wash contains aliphatic hydrocarbons, cyclohexane, n-heptane, methylcyclohexane, toluene, C_6-C_8 paraffins, and C_6-C_8 cycloparaffins) and the other wash contains aromatic hydrocarbons, aliphatic hydrocarbons, 1,2,4-trimethylbenzene, xylene, dipropylene glycol methyl ether, and propylene glycol methyl ether. Typically, the blanket is wiped down twice during cleaning: once with blanket wash to remove the ink, and once with a clean, dry shop towel to remove excess wash. Blanket wash is applied directly to the blanket using a squirt bottle and is then wiped off using a reusable shop towel. The same shop towel is used until it has too much ink build-up to effectively clean the blanket. This application procedure was modified slightly for the baseline wash and substitute wash demonstrations in that the wash was poured onto the shop towel instead of directly on the blanket.

Wash 26 was comparable in performance effectiveness to both the baseline wash and the standard wash used by Facility 5. Wash 26 earned a performance designation of good for every blanket on which it was used during the week-long performance demonstration. The baseline and facility standard washes also received good performance ratings. The effort required to wash the blanket for both the baseline and substitute washes was described as moderate by the press operator. The time required to wash the blanket (as measured by number of rotations) was roughly equal to the baseline wash. Wash 26 cut the ink well across all ink coverages, but left a slight oily residue on the blanket after the initial blanket wiping with wash. This oily residue was removed at the dry wipe step of the blanket washing process and did not cause print quality problems. However, this oily residue did cause problems when Wash 26 was used to wash the press rollers. When used on rollers, the oily residue caused ink splotches to occur. This resulted in time delays during the full press wash procedure as two products were necessary: the standard facility wash for roller cleaning and Wash 26 for blanket cleaning. The press operator commented that the use of the same product for both roller and blanket cleaning is an important cost and effort consideration for his facility.

Facility 15

Facility 15 prints commercial products (brochures), direct-mail products, and other publications. Performance demonstrations at this facility were conducted on a two-unit, 19" x 25" press using conventional inks. The standard wash contains aromatic hydrocarbons, polyglycol ether, and aliphatic hydrocarbons (as stated on the MSDS) and, according to the press operator, cuts the ink well, but does have somewhat of an odor. In the past, Facility 15 tried an alternative blanket wash, but it did not work well and it had a very offensive odor. Recently, this facility installed a new press with an automatic blanket washer. In their standard manual blanket washing procedure, the press operator at this facility pours the blanket wash on to a reusable shop

towel, wipes the ink off the blanket in one rotation, then uses a dry shop towel for one rotation to remove the excess wash. This same procedure was used for both the baseline and the substitute wash.

Wash 26 performed as well as the baseline wash and the standard wash used by Facility 15. Wash 26 received a performance rating of good on the good-fair-poor scale from the press operator after every one of its 22 trials in the week-long performance demonstration. The time required to wash the blankets (as measured by the number of rotations) was equal to the baseline wash. The physical effort required to clean the blanket was described as low for all ink coverages. Over the course of the performance demonstration, Wash 26 did not leave a residue on the blanket and did not affect print quality. The press operator who conducted the performance demonstration stated that Wash 26 would be purchased by his facility if appropriately priced, as well as beneficial from an environmental, worker health, and safety standpoint.

Summary of Performance Demonstrations for Blanket Wash 26

Laboratory Testing Results								
Product	**VOC Content (lbs/gal; % by wt)**	**Flashpoint (°F)**	**pH**	**Vapor Pressure (reported, mm Hg)**	**Blanket Swell (%)**		**Washability (# strokes)**	
					1 hour	***5 hour***	***Wet Ink***	***Dry Ink***
WASH 26	1.3; 18%	230+	7.8	<1 @ 77°F	0	0	6	14
Baseline Wash	6.2; 100%	50	6.6	15 @ 100°F	1.5	3	3	8

Field Demonstration Results								
Product/ Facility	**Average Volume Used (ounces)**	**Time required[c] (# rotations)**			**Physical Effort Required (Low, Medium, or High)**			**Performance Evaluation**
		Light Coverage	*Medium Coverage*	*Heavy Coverage*	*Light Coverage*	*Medium Coverage*	*Heavy Coverage*	
WASH 26 at Facility 5	0.5 ± 0.1 (n=14)[b]	2.0 ± 0.0	2.3 ± 0.7	NA	Low	Medium	NA	*Based on a sample size of 14 blanket washes:* • Good performance rating after every wash. • Performed as well as both standard facility wash and baseline wash. • Slight oily residue caused print quality problems when wash was used for roller clean-up.
Baseline Wash at Facility 5	1.0 (n=1)	2.0 ± 0.0	NA	NA	Medium	NA	NA	• Cut ink satisfactorily.
WASH 26 at Facility 15	0.7 ± 0.1 (n=22)	2.0 ± 0.0	2.0 ± 0.0	2.0 ± 0.0	Low	Low	Low	*Based on a sample size of 22 blanket washes:* • Good performance rating after every wash. • Performed as well as standard facility wash and baseline wash.
Baseline Wash at Facility 15	1.5 ± 0.7 (n=2)	2.0 ± 0.0	NA	NA	Low	NA	NA	• Cut ink well. • Low effort required. • Good performance rating.

NA = Not Applicable; product was not demonstrated under these conditions.

[a] pH fluctuates

[b] n = number of washes on which this data is based, as recorded by the printer.

[c] Time required to clean the blanket measured by the number of blanket rotations: Avg. time per rotation = 60.0 sec. at Facility 5 and 30.0 sec. at Facility 15 (based on time recorded by the project observer)

Blanket Wash 29

Composition:
Fatty acid derivatives

VOC Content: 30%; 2.1 lbs/gal
Flashpoint: 230+°F
pH: 7.2

Facility 7

At Facility 7, Wash 29 was used on a single-unit 20" x 26" press with conventional inks to print commercial products such as brochures and advertisements. The press operator cleaned only one blanket using Wash 29 after the observer left, and then stopped the demonstration because the substitute wash was found to leave an unacceptable, thick, oily film on the blanket. The following information is, therefore, based on the observer data. At this facility, each blanket is typically wiped down two times during cleaning: once to remove the ink with a reusable shop towel soaked with blanket wash, and once with a clean, dry shop towel to remove excess wash. Blanket wash is applied to the shop towel using a squirt bottle and the shop towel is resoaked with wash prior to reuse on other blankets. The same shop towel is used until it has too much ink build-up to effectively clean the blanket. The standard blanket wash at Facility 7 contains petroleum distillates, 2-butoxyethanol and a proprietary surfactant, according to the MSDS.

Based on the four blanket cleanings with Wash 29, the press operator at Facility 7 found its performance to be "poor". The baseline wash was observed to perform well; cutting the ink well and drying quickly. Although the press operator felt that Wash 29 cut the ink with about the same effectiveness as the baseline wash, the product was very oily, would not dry off of the operator's hands and left an oily residue on the blanket that was very difficult to remove. Additional time and effort were needed to remove as much of the residue as possible using a clean dry shop towel, but some of the oily film was still present after this procedure. Although no difference was noticed between the time to clean the blankets using the baseline wash and Wash 29, the level of physical effort needed to wash the blanket was rated as "high" for the substitute wash compared to "medium" for the baseline wash. The oily film from Wash 29 was observed to slightly increase the number of copies required to return to acceptable print quality after restarting the press. The thick oily consistency of the product also increased overall effort because it made it difficult to get the wash to soak into the shop towel. The press operator did notice, however, that the smell of the product was not as strong as the baseline wash or the facility's standard wash.

Facility 8

Facility 8 used a 6-unit 20" x 26" press with conventional inks to print brochures, advertisements and other commercial products. The press operator at Facility 8 used Wash 29 for all jobs during the one-week demonstration. At this facility, each blanket is typically wiped down two times during cleaning: once with a reusable shop towel saturated with blanket wash, and once with a clean dry shop towel to remove excess wash. The saturated shop towel is typically used to clean all six blankets on the press before being resaturated or sent out for laundering. This application procedure was also used for the application of the baseline wash and the substitute wash. Facility 8 was using a wash which contains aliphatic petroleum distillates, aromatic petroleum distillates, xylene, 2-butoxy ethanol, methylene chloride, diacetone alcohol, diisononyl phthalate, 2,6-di-tert-butyl-p-cresol, ethylbenzene and 1,2,4 trimethylbenzene (according to the MSDS) to clean the blankets prior to and following the blanket wash demonstration. Alternative low-VOC blanket wash were experimented with in the past, but they did not cut the ink well, did not dry fast and left and oily residue on the blanket.

The press operator at Facility 8 evaluated the performance of Wash 29 as "poor". The operator found that Wash 29 did not cut the ink as well as the baseline product and did not remove paper dust and powder. The baseline product was observed to cut the ink well and dry quickly, but required some extra effort to drag it across the blanket surface. Using Wash 29, more time and much more effort were needed to remove the ink than was needed with the baseline product. Under medium ink coverage conditions, the average number of rotations required to clean the blanket using Wash 29 was 4.0 compared to 2.7 for the baseline wash. Because the average time to rotate a blanket was 15.5 seconds at facility 8, the average blanket cleaning time increased by 20 seconds under medium ink coverage conditions over the baseline wash. The press operator rated the effort needed to clean the blankets using both the baseline wash and Wash 29 as "high" under medium ink coverage conditions due to the extra time needed to remove the ink. The effort to use the baseline wash was rated as "high" because the operator found it to have high resistance when dragging it across the blanket and the effort to use the substitute wash was rated as "high" due to the extra rotations needed to remove the ink. The substitute wash was also observed to leave a slight oily film on the blanket, but no effect was observed on the print quality. The press operator noticed that the substitute wash's odor was agreeable and not too strong.

Summary of Performance Demonstrations for Blanket Wash 29

Laboratory Testing Results								
Product	**VOC Content (lbs/gal; % by wt)**	**Flashpoint (°F)**	**pH**	**Vapor Pressure (reported, mm Hg)**	**Blanket Swell (%)**		**Washability (# strokes)**	
					1 hour	***5 hour***	***Wet Ink***	***Dry Ink***
WASH 29	2.1; 30%	230+	7.2	<1 @ 68°F	1.5	1.5	9	18
Baseline Wash	6.2; 100%	50	6.6	15 @ 100°F	1.5	3.0	3	8

Field Demonstration Results								
Product/ Facility	**Average Volume Used (ounces)**	**Time required[b] (# rotations)**			**Physical Effort Required (Low, Medium, or High)**			**Performance Evaluation**
		Light Coverage	*Medium Coverage*	*Heavy Coverage*	*Light Coverage*	*Medium Coverage*	*Heavy Coverage*	
WASH 29 at Facility 7[c]	1.0 ± 0.0 (n=3)	NA	2.0 ± 0.0	NA	NA	High	NA	*Based on a sample size of 3 blanket washes:* • Good performance; cut ink well. • Extra effort was required to dry the blanket.
Baseline Wash at Facility 7	1.2 ± 0.0 (n=2)	NA	2.0 ± 0.0	NA	NA	Medium	NA	• Good performance; cut ink well.
WASH 29 at Facility 8	0.8 ± 0.6 (n=36)	4.1 ± 0.8	4.0 ± 0.0	NA	Medium	High	NA	*Based on a sample size of 36 blanket washes:* • Did not cut ink as well as baseline wash. • Did not cut paper dust or powder. • More effort was required to remove slight oily film on blanket.
Baseline Wash at Facility 8	0.7 ± 0.0 (n=4)	NA	2.7 ± 0.5	NA	NA	High	NA	• Good performance; cut ink well. • Extra effort was required due to resistance to being dragged across the blanket.

NA = Not Applicable; product was not demonstrated under these conditions.

[a] n = number of washes on which this data is based, as recorded by the printer.

[b] Time required to clean the blanket measured by the number of blanket rotations. Avg. time per rotation = 27.5 sec. at Facility 7 and 15.5 sec. at Facility 8 (based on time recorded by the project observer)

[c] Based on observer's data; printer data not received.

Blanket Wash 30

Composition:
Hydrocarbons, aromatic
Propylene glycol ethers
Water

VOC Content: 7%; 0.48 lbs/gal
Flashpoint: 100°F (full strength)
pH: 7.6 (25%)

Facility 18

At Facility 18, Wash 30 was used on a single-unit 20" x 30" press and a 2-unit, 19" x 26" press with soy oil-based inks and commercial products such as business forms and brochures were printed. The press operator used Wash 19 for the four days that the presses were operating during the one-week demonstration period which resulted in only three blanket cleanings. At this facility, each blanket is typically wiped down three times during cleaning: twice with a reusable shop towel soaked with blanket wash, and once with a dry shop towel to remove excess blanket wash. Blanket wash is applied to the shop towel using a squirt bottle and the shop towel is resoaked with wash prior to reuse on other blankets. The same shop towel is used until it has too much ink build-up to effectively clean the blanket. Currently, this facility cleans their blankets using a product which contains aliphatic hydrocarbons, according to the MSDS. Other than changing the number of rotations to clean a blanket, this application procedure was not modified during the demonstration of the substitute product. Facility 18 had tried an alternative low-VOC blanket wash, but found that it did not dry as fast as their standard product and was more expensive.

Based on the three blanket cleanings with Wash 30, the press operator at Facility 18 evaluated its performance as "fair". The baseline wash was found to cut the ink well, but required additional effort due to the wash's high resistance to the blanket surface. Wash 30 was only tested under heavy ink coverage conditions and the baseline wash was observed under light and medium coverage conditions. The substitute wash was observed to require about the same amount of time as measured by blanket rotations under heavy ink coverage conditions as the baseline wash required under medium coverage conditions. The press operator found that Wash 30 cut the ink well and overall it performed with about the same effectiveness as the baseline wash. Following the manufacturer's instructions, the substitute wash was tried with 25% dilution with water, but was found to perform better at full strength. The press operator rated the effort needed to clean a blanket with heavy ink coverage as "medium". Although the baseline wash was not tested under those conditions, the operator felt that the amount of physical effort needed to clean the blanket with Wash 30 would be about the same as that of the baseline wash. The press operator also observed that when accidentally spilled on a clear plastic guard on the press, Wash 30 permanently clouded the plastic, necessitating its replacement.

Facility 19

Facility 19 used a 2-unit 19" x 26" press also with soy oil-based inks to print brochures, cards, and other commercial products. The press operator at Facility 19 used Wash 30 for the entire one-week demonstration. The operator typically cleans the blanket by pouring the blanket wash onto a clean, reusable shop towel and wiping the blanket while rotating it manually twice. The blanket is then allowed to dry by evaporation before restarting the press. This application procedure was also used for the application of the baseline wash. When using Wash 30, the press

operator modified the application procedure slightly and wiped the blanket with a dry shop towel before resuming the print job. The standard wash used at this facility contains aromatic hydrocarbons, polyglycol ethers, aliphatic hydrocarbons, and a proprietary combustible chemical. Prior to this project, they did some experimenting with another substitute wash, but it did not work as well as their standard product and it was irritating to the skin as well. In the past, they used an automatic blanket washer, hoping to reduce their blanket wash chemical use and labor, but they discontinued using it after they found it required more effort and wasted solvent.

The press operator at Facility 19 evaluated the performance of Wash 30 as "fair". The substitute product was found to cut the ink well, but required additional effort because the substitute wash did not evaporate off of the blanket quickly and needed to be wiped off with a clean dry shop towel and the product's thick consistency made it difficult and "messy" to use. The baseline wash was found to cut the ink well, but required additional effort due to the wash's high resistance to the blanket surface. On average, about one extra rotation of the blanket was required with the substitute wash compared to the baseline wash due to the additional step needed to dry the blanket. Because the average time to rotate a blanket was 18.5 seconds at facility 19, the increase in blanket cleaning time was not substantial. The press operator rated the effort needed as "high" for both the baseline and the substitute washes. The effort needed to use the substitute wash was rated as "high" due to the additional drying step, difficulty in getting the wash to soak into a shop towel, and because the operator found it had a slight resistance to the blanket surface. The effort to use the baseline wash was rated as "high" because the operator found the baseline wash had unusually high resistance to the blanket surface. An oily film was noticed on the blanket after using Wash 30, but the operator felt that the film had only a slight effect on the number of copies needed to get back to print quality after restarting the press.

Summary of Performance Demonstrations for Blanket Wash 30

Laboratory Testing Results								
Product	**VOC Content (lbs/gal; % by wt)**	**Flashpoint (°F)**	**pH**	**Vapor Pressure (reported, mm Hg)**	**Blanket Swell (%)**		**Washability (# strokes)**	
					1 hour	***5 hour***	***Wet Ink***	***Dry Ink***
WASH 30	0.48; 7%	100	7.6	2.2 @ 68°F	0.7	1.5	5	11
Baseline Wash	6.2; 100%	50	6.6	15 @ 100°F	1.5	3	3	8

Field Demonstration Results								
Product/ Facility	**Average Volume Used (ounces)**	**Time required[b] (# rotations)**			**Physical Effort Required (Low, Medium, or High)**			**Performance Evaluation**
		Light Coverage	*Medium Coverage*	*Heavy Coverage*	*Light Coverage*	*Medium Coverage*	*Heavy Coverage*	
WASH 30 at Facility 18	4.0 ± 0.0 (n=3)[a]	NA	NA	3.3 ± 0.6	NA	NA	Medium	*Based on a sample size of 3 blanket washes:* • Good performance; cut ink well. • Worked best with no dilution with water.
Baseline Wash at Facility 18	1.5 ± 0.8 (n=6)	2.7 ± 0.5	3.5 ± 0.7	NA	Low	Low	NA	• Good performance; cut ink well.
WASH 30 at Facility 19	0.7 ± 0.0 (n=8)	3.0 ± 0.0	3.0 ± 0.0	NA	High	High	NA	*Based on a sample size of 8 blanket washes:* • Cut ink well. • Required extra effort to dry oily film from blanket. • Thick consistency was difficult to use. • Extra effort was required due to resistance to surface of the blanket.
Baseline Wash at Facility 19	0.9 ± 0.2 (n=5)	2.2 ± 0.4	NA	NA	High	NA	NA	• Good performance; cut ink well. • Extra effort was required due to resistance to surface of the blanket.

NA = Not Applicable; product was not demonstrated under these conditions.

[a] n = number of washes on which this data is based, as recorded by the printer.

[b] Time required to clean the blanket measured by the number of blanket rotations: Avg. time per rotation = 16.2 sec. at Facility 18 and 18.5 sec. at Facility 19 (based on time recorded by the project observer)

Blanket Wash 31

Composition:
Hydrocarbons, aromatic
Hydrocarbons, petroleum distillates

VOC Content: 99%; 6.6 lbs/gal
Flashpoint: 105°F
pH: 7.6

Facility 7

At Facility 7, Wash 31 was used on a single-unit 20" x 26" press with conventional inks to print commercial products such as brochures and advertisements. The press operator at Facility 7 used Wash 31 for all jobs during the one-week demonstration which resulted in only 4 cleanings. At this facility, each blanket is typically wiped down two times during cleaning: once to remove the ink with a reusable shop towel soaked with blanket wash, and once with a clean, dry shop towel to remove excess wash. Blanket wash is applied to the shop towel using a squirt bottle, and the shop towel is resoaked with wash prior to reuse on other blankets. The same shop towel is used until it has too much ink build-up to effectively clean the blanket. The standard blanket wash at Facility 7 contains petroleum distillates, 2-butoxyethanol and a proprietary surfactant, according to the MSDS.

The press operator at Facility 7 evaluated Wash 31 as "fair". Wash 31 was observed to cut the ink well, but did not dry as fast as the baseline wash. The baseline wash was observed to perform well; cutting the ink well and drying quickly. Although not reflected in the data, the operator felt that some additional time and effort were needed to remove the excess wash using a clean, dry shop towel. Under medium ink coverage conditions, no difference was noticed between the time to clean the blankets as measured by the number of rotations using the baseline wash or Wash 31. However, the level of physical effort needed to wash the blanket was rated as "high" for the substitute wash compared to "medium" for the baseline wash. The press operator noticed that the smell of the substitute wash was noticeable, but not disagreeable.

Facility 8

Facility 8 used a 6-unit 20" x 26" press with conventional inks to print brochures, advertisements and other commercial products. The press operator at Facility 8 used Wash 31 for all jobs during the one-week demonstration. At this facility, each blanket is typically wiped down two times during cleaning: once with a reusable shop towel saturated with blanket wash, and once with a clean dry shop towel to remove excess wash. The saturated shop towel is typically used to clean all six blankets on the press before being resaturated or disposed. This application procedure was also used for the application of the baseline wash and the substitute wash. Facility 8 was using a product containing aliphatic petroleum distillates, aromatic petroleum distillates, xylene, 2-butoxy ethanol, methylene chloride, diacetone alcohol, diisononyl phthalate, 2,6-di-tert-butyl-p-cresol, ethylbenzene and 1,2,4 trimethylbenzene, according to the MSDS, to clean the blankets prior to and following the blanket wash demonstration. Alternative low-VOC blanket washes were experimented with in the past, but they did not cut the ink well, did not dry fast, and left an oily residue on the blanket.

Overall, the performance of Wash 31 was considered "good/fair". Wash 31 was tested under light, medium and heavy ink conditions, while the baseline wash was observed only under medium

coverage conditions. The press operator observed that the wash cut the ink well, dried quickly and performed about as well as the baseline wash. Under medium coverage conditions, it was observed that the substitute wash required less time to clean the blankets than the baseline wash. Somewhat more of Wash 31 was needed, however, to remove the ink in comparison to the baseline wash (0.7 ounces for the baseline wash compared to 1.1 ounces for the substitute wash). The press operator rated the effort needed to clean the blankets using Wash 31 as "low" under all coverage conditions, although he did note that there was slightly more resistance to the blanket surface. The effort needed to use the baseline wash was rated as "high" because the operator found it to have unusually high resistance to the blanket.

Summary of Performance Demonstrations for Blanket Wash 31

Laboratory Testing Results								
Product	**VOC Content (lbs/gal; % by wt)**	**Flashpoint (°F)**	**pH**	**Vapor Pressure (reported, mm Hg)**	**Blanket Swell (%)**		**Washability (# strokes)**	
					1 hour	***5 hour***	***Wet Ink***	***Dry Ink***
WASH 31	6.6; 99%	105	7.6	<0.1 @ 68°F	1.5	3.0	3	3
Baseline Wash	6.2; 100%	50	6.6	15 @ 100°F	1.5	3.0	3	8

Field Demonstration Results								
Product/ Facility	**Average Volume Used (ounces)**	**Time required[b] (# rotations)**			**Physical Effort Required (Low, Medium, or High)**			**Performance Evaluation**
		Light Coverage	*Medium Coverage*	*Heavy Coverage*	*Light Coverage*	*Medium Coverage*	*Heavy Coverage*	
WASH 31 at Facility 7	1.5 ± 0.6 (n=4)[a]	2.0 ± 0.0	2.0 ± 0.0	NA	High	High	NA	*Based on a sample size of 4 blanket washes:* • Cut the ink well; slightly more effort needed to remove oily residue on blanket. • Oily residue slightly increased the copies required to return to print quality. • Smell not as strong as facility's standard wash or baseline wash.
Baseline Wash at Facility 7	1.2 ± 0.0 (n=2)	NA	2.0 ± 0.0	NA	NA	Medium	NA	• Good performance; cut ink well.
WASH 31 at Facility 8	1.1 ± 1.5 (n=61)	2.0 ± 0.0	2.0 ± 0.0	2.1 ± 0.2	Low	Low	Low	*Based on a sample size of 61 blanket washes:* • Good performance; cut ink well • Performed as well as standard wash. • Slightly more effort was required due to resistance to surface of the blanket.
Baseline Wash at Facility 8	0.7 ± 0.0 (n=4)	NA	2.7 ± 0.5	NA	NA	High	NA	• Good performance; cut ink well. • Extra effort was required due to resistance to the surface of the blanket.

NA = Not Applicable; product was not demonstrated under these conditions.

[a] n = number of washes on which this data is based, as recorded by the printer.

[b] Time required to clean the blanket measured by the number of blanket rotations: Avg. time per rotation = 82.5 sec. at Facility 7 and 17.1 sec. at Fac. 8 (based on time recorded by the observer)

Blanket Wash 32

Composition:
Hydrocarbons, petroleum distillates

VOC Content: 99%; 6.5 lbs/gal
Flashpoint: 220°F
pH: 8.5

Facility 1

At Facility 1, performance demonstrations were conducted on an eight-unit, 28" x 40" press using vegetable-based inks to print high quality, multi-color, commercial products. Currently, Facility 1 uses a blanket wash which consists of aromatic hydrocarbons, 1,2,4-trimethylbenzene, and aliphatic hydrocarbons, according to the MSDS. In the months preceding the demonstrations, the facility had tried two different low-VOC blanket washes; neither worked as well as their standard wash. At this facility, each blanket is typically wiped down twice during cleaning: once with a reusable shop towel saturated in blanket wash to remove the ink, and once with a dry shop towel to remove excess blanket wash. Each saturated shop towel is used to clean two blankets. The same application procedure was used for the baseline and substitute products. The quantity of wash needed to saturate the shop towel and clean the blanket remained constant throughout the demonstration, regardless of the ink coverage or ink build-up on the blanket. There were both positive and negative aspects to this application method. While more wash than was needed may have been used in some cases, the consistency of the application volume made it possible to compare the performance of the standard, baseline, and substitute products under the same conditions.

Overall, the performance of Wash 32 was considered "fair/poor." Although it cut the ink well, more effort was required than with the baseline wash. When using the baseline wash, the operator found it cut it the ink well, but required some more effort than their standard wash. The additional effort to clean the blanket with Wash 32 was needed to remove the oily residue that remained on the blanket. With Wash 32, an average of 4 rotations (approximately 80 seconds) were needed to clean the blanket, whereas with the baseline product, only 2 rotations (40 seconds) were required. After using Wash 32, the residue persisted, even after wiping down the blanket with two dry wipes. The press operator commented that normally a slight residue may not be a problem, but in this case, it caused problems with future print quality. On subsequent images, there was visible "chatter" (faint, inconsistent lines where the color is supposed to be uniformly solid) on the print. Eventually, the residue is picked up in the prints and the chatter is only a temporary problem, however, more impressions are needed to get back up to acceptable quality than with the standard or baseline wash. After eight blanket cleanings (four with the observer present and four more conducted by the printer), Facility 1 decided to discontinue the performance demonstration with Wash 32.

Facility 5

At Facility 5, performance demonstrations were conducted using a single-unit, 12" x 18" press with conventional inks to print commercial products such as business cards and advertisements. According to the MSDSs, this facility currently uses either a blanket wash which contains aliphatic hydrocarbons, cyclohexane, n-heptane, methylcyclohexane, toluene, C_6-C_8 paraffins, and C_6-C_8 cycloparaffins or one that consists of aromatic hydrocarbons, aliphatic hydrocarbons, 1,2,4-trimethylbenzene, xylene, dipropylene glycol methyl ether, and propylene glycol methyl ether. Facility 5 has tried several substitute blanket washes that were donated by

their supplier. None of these products were adopted either because they did not work as well as their standard wash (left an oily residue on the blanket) or they were too expensive (up to twice as much as their standard wash). The facility has reduced the quantity of solvent used by reusing the drying shop towel from the previous wash for the application of blanket wash in the subsequent blanket wash procedure. This reduced the amount of solvent used, the number of shop towels sent to the laundry and the associated laundering costs, and the environmental impacts such as laundry wastewater and energy usage. Typically, the blanket is wiped down twice during cleaning: once with blanket wash to remove the ink, and once with a clean, dry shop towel to remove excess wash. Blanket wash is applied directly to the blanket using a squirt bottle and is then wiped off using a reusable shop towel. The same shop towel is used until it has too much ink build-up to effectively clean the blanket. This application procedure was modified slightly for the baseline wash and substitute wash demonstrations in that the wash was poured onto the shop towel instead of directly on the blanket.

Wash 32 was used for one week and 12 washes were recorded by the press operator. Overall, the performance of Wash 32 was rated "good." When compared to the baseline wash (which cut the ink well and cleaned the blanket as well as their standard wash), the effort needed to clean the blanket with Wash 32 was slightly higher because Wash 32 left an oily residue on the blanket. With the baseline or the standard wash, one rotation with a dry shop towel was enough to remove the excess wash. With Wash 32, two or three rotations with the dry wipe were required. On average, the drying time increased from approximately 21 seconds using the baseline or standard wash to approximately 32 seconds using Wash 32. This extra drying step increased the effort required, however, the residue did not affect future print quality. The printer commented that the slight residue came off quickly during the normal waste sheet portion of the next run.

During the demonstration, Wash 32 was used on light, medium, and heavy ink coverage; all with good results. It should be noted that heavy ink coverage for a business card, is not the equivalent of heavy ink coverage for larger print operations. The printer at Facility 5 felt the oily residue could cause some problems on a bigger press with greater ink coverage.

Summary of Performance Demonstrations for Blanket Wash 32

Laboratory Testing Results								
Product	**VOC Content (lbs/gal; % by wt)**	**Flashpoint (°F)**	**pH**	**Vapor Pressure (reported, mm Hg)**	**Blanket Swell (%)**		**Washability (# strokes)**	
					1 hour	***5 hour***	***Wet Ink***	***Dry Ink***
WASH 32	6.5; 99%	220 8.5	8.5	<1 @ 68°F	0.1	1.5	5	30
Baseline Wash	6.2; 100%	50 6.6	6.6	15 @ 100°F	1.5	3	3	8

Field Demonstration Results								
Product/ Facility	**Average Volume Used (ounces)**	**Time required[b] (# rotations)**			**Physical Effort Required (Low, Medium, or High)**			**Performance Evaluation**
		Light Coverage	*Medium Coverage*	*Heavy Coverage*	*Light Coverage*	*Medium Coverage*	*Heavy Coverage*	
WASH 32 at Facility 1	2.5 ± 0.0 (n=4)[a]	NA	4.2 ± 0.5	NA	NA	High	NA	*Based on a sample size of 4 blanket washes:* • Good performance. • Required slightly higher effort to remove excess wash than with the standard wash.
Baseline Wash at Facility 1	2.5 ± 0.0 (n=2)	2.0 ± 0.0	2.0 ± 0.0	NA	High	High	NA	• Fair/poor performance. • Oily residue caused "chatter" in subsequent prints.
WASH 32 at Facility 5	0.7 ± 0.2 (n=12)	3.0 ± 0.0	3.0 ± 0.0	3.0 ± 0.0	Low	Medium	Medium	*Based on a sample size of 12 blanket washes:* • Good performance. • Left slight, oily residue that was removed with dry shop towels and did not affect print quality.
Baseline Wash at Facility 5	1.0 (n=1)	2	NA	NA	Low	NA	NA	• Good performance. • Cut ink well with same effort as standard wash.

NA = Not Applicable; product was not demonstrated under these conditions.
NC = Not Calculated; VOC content as a % by weight could not be calculated because specific gravity data was not available.
[a] n = number of washes on which this data is based, as recorded by the printer.
[b] Time required to clean the blanket measured by the number of blanket rotations: Avg. time per rotation = 20.0 sec at Facility 1 and 10.6 sec at Facility 5 (based on time recorded by the observer)

Blanket Wash 34

Composition:
Water
Terpenes
Hydrocarbons, petroleum distillates
Alkoxylated alcohols
Fatty acid derivatives

VOC Content: 39%; 2.8 lbs/gal
Flashpoint: 138°F
pH: 6.6

Facility 1

At Facility 1, performance demonstrations were conducted on an eight-unit, 28" x 40" press using vegetable-based inks to print high quality, multi-color, commercial products. Currently, Facility 1 uses a blanket wash which consists of aromatic hydrocarbons, 1,2,4-trimethylbenzene, and aliphatic hydrocarbons, according to the MSDS. In the months preceding the demonstrations, the facility had tried two different low-VOC blanket washes; neither worked as well as their standard wash. At this facility, each blanket is typically wiped down twice during cleaning: once with a reusable rag saturated in blanket wash to remove the ink, and once with a dry rag to remove excess blanket wash. Each saturated rag is used to clean two blankets. The same application procedure was used for the baseline and substitute products. The quantity of wash needed to saturate the rag and clean the blanket remained constant throughout the demonstration, regardless of the ink coverage or ink build-up on the blanket. There were both positive and negative aspects to this application method. While more wash than was needed may have been used in some cases, the consistency of the application volume made it possible to compare the performance of the standard, baseline, and substitute products under the same conditions.

The operator used Wash 34 for one week and cleaned 37 blankets. The wash performance was considered "good;" this facility used five different substitute washes over a two month period for the performance demonstrations project and the press operator considered Wash 34 to be the best performer. During the course of the week, the operator recorded data on the performance of Wash 34 on blankets with all levels of ink coverage. On blankets with light or medium ink coverage, Wash 34 cut the ink well with the same level of effort as was used when cleaning with the baseline or standard wash. For light and medium ink coverage, the operator considered the performance to be "good" for all washes. On blankets with heavy ink coverage, slightly more effort was required than with the standard wash. For the 19 blankets cleaned where ink coverage was heavy, performance was rated as "good" on 12 blankets (63%) and "fair" for 7 blankets (37%). The press operator noticed that the product had a "very dry feel" to it. He found performance and ease of use improved when he wiped the blanket with a sponge soaked with water before applying Wash 34. Wiping the blanket with a wet sponge prior to application of the wash is often done to remove paper build-up, so the printer did not consider this step to be an extra effort.

Performance of Wash 34 was comparable to that of the baseline wash (which cut the ink well, and required the same amount of time as their standard wash, but did require some additional effort to remove the oily residue). Average time required to clean the blanket with the baseline wash was approximately 40 seconds for light or medium ink coverage, and with Wash 34, average cleaning time varied between 40 and 60 seconds.

Facility 19

For the performance demonstrations, Facility 19 used a 2-unit, 19" x 26" press with soy oil-based inks to print brochures, cards, and other commercial products. The standard wash used at this facility contains aromatic hydrocarbons, polyglycol ethers, aliphatic hydrocarbons, and a proprietary combustible chemical, according to the MSDS. Prior to this project, they did some experimenting with another substitute wash, but it did not work as well as their standard product and it was irritating to the skin as well. In the past, they used an automatic blanket washer, hoping to reduce their blanket wash chemical use and labor, but they discontinued using it after they found it required more effort and wasted solvent. Typically, the operator at Facility 19 cleans the blanket by pouring the blanket wash onto a clean, reusable shop towel and wiping the blanket while rotating it manually twice. The blanket is then allowed to dry by evaporation before restarting the press. This application procedure was also used for the application of the baseline wash. When using the substitute Wash 34, the press operator modified the application procedure slightly and wiped the blanket with a dry shop towel before resuming the print job.

This printer considered the performance of Wash 34 to be "fair" or "poor" for light, medium, and heavy ink coverage. Data sheets were completed for 13 blanket washes. The printer found that Wash 34 left a light coating on the blanket, and often "high" effort was needed to remove this residue. The consistency of the wash was another problem: the printer found that the thick consistency of the wash prevented it from soaking into the shop towel easily. Before he could apply the wash, the press operator had to work it into the shop towel, additionally increasing the effort needed to clean the blanket with Wash 34. It took longer to clean the blanket with Wash 34 than with the baseline wash. The baseline wash cut the ink well, but required slightly more effort than their standard wash. Additional effort was due to the increased drag of the shop towel over the blanket; the baseline wash was not as smooth as their standard wash. The printer did note that fewer impressions were needed to get back up to acceptable print quality after cleaning the blanket with the baseline product. When ink coverage was light, the average time to clean the blanket with Wash 34 was approximately 65 seconds; with the baseline wash the average cleaning time was approximately 40 seconds.

Summary of Performance Demonstrations for Blanket Wash 34

Laboratory Testing Results								
Product	**VOC Content (lbs/gal; % by wt)**	**pH**	**Flashpoint (°F)**	**Vapor Pressure (reported, mm Hg)**	**Blanket Swell (%)**		**Washability (# strokes)**	
					1 hour	***5 hour***	***Wet Ink***	***Dry Ink***
WASH 34	2.8; 39%	6.6	138	2 @ 68°F	1.5	3	10	20
Baseline Wash	6.2; 100%	6.6	50	15 @ 100°F	1.5	3	3	8

Field Demonstration Results								
Product/ Facility	**Average Volume Used (ounces)**	**Time required[c] (# rotations)**			**Physical Effort Required (Low, Medium, or High)**			**Performance Evaluation**
		Light Coverage	*Medium Coverage*	*Heavy Coverage*	*Light Coverage*	*Medium Coverage*	*Heavy Coverage*	
WASH 34 at Facility 1	2.5 ± 0.0 (n=37)[a]	2.6 ± 0.6	2.2 ± 0.4	3.1 ± 1.0	Medium	Medium	High	*Based on a sample size of 37 blanket washes:* • Good performance; best of the 5 substitute washes demonstrated at this facility. • Cut the ink well with the same effort as with the standard wash for light/medium ink coverage. • Slightly more effort needed for heavy ink coverage, but acceptable.
Baseline Wash at Facility 1	2.5 ± 0.0 (n=2)	2.0 ± 0.0	2.0 ± 0.0	NA	High	High	NA	• Good performance. • Required slightly more effort than standard wash.
WASH 34 at Facility 19	1.2 ± 0.4 (n=13)[b]	3.6 ± 0.6	4.0 ± 0.0	3.7 ± 0.5	Medium	Medium	High	*Based on a sample size of 13 blanket washes:* • Fair/Poor performance. • Cut the ink well, but did not soak into shop towel and extra effort was needed to remove the oily residue.
Baseline Wash at Facility 19	0.9 ± 0.2 (n=5)	2.2 ± 0.4	NA	NA	High	NA	NA	• Good performance. • Fewer impressions were needed to get back to acceptable print quality than with standard wash.

NA = Not Applicable; product was not demonstrated under these conditions.

[a] n = # of washes recorded by the printer;

[b] n = # of washes recorded by the observer.

[c] Time required to clean the blanket measured by the number of blanket rotations: Avg. time per rotation = 20.0 sec at Facility 1 (measured by the observer); 18 sec at Facility 19 (estimated).

Blanket Wash 37

Composition:
Water
Hydrocarbons, petroleum distillates
Hydrocarbons, aromatic

VOC Content: 14%; 1.0 lbs/gal
Flashpoint: 82°F
pH: 3.9

Facility 3

Facility 3 used Wash 37 on a 2-unit, 18" x 25" press, with conventional inks to print a variety of commercial products. Facility 3 had used a new blanket wash for health, safety or environmental reasons on one occasion prior to the performance demonstration. The wash had not been adopted because it left an oily residue on the blanket and took too long to dry. Normal blanket washing procedure is the following: a squirt bottle is used to apply blanket wash to a reusable shop towel, the shop towel is then used to wipe the blanket as it is manually rotated, and the blanket is allowed to air dry. Standard facility blanket wash was a mixture of aliphatic and aromatic hydrocarbons, according to the MSDS. The application procedure was changed for the performance demonstration. Wash 37 did not dry as quickly as the standard facility wash, so a dry shop towel was used to remove the residue from the blanket after the washing step. For each blanket cleaning, the procedure was to apply only a sufficient amount of wash to the shop towel. Press operators increased the amount of Wash 37 applied to the shop towel as ink coverage on the blanket increased.

Press operators had no problems with Wash 37 during the performance demonstration. Wash 37 drying time was slightly greater than for the baseline and standard facility washes, but, according to press operators, Wash 37 performed as well overall. Wash 37 received good and fair performance ratings on light and medium ink coverage print jobs, respectively, as there were no heavy ink coverage jobs during the week of the performance demonstration. According to press operators, medium ink coverage jobs required more effort to clean than light ink coverage jobs with Wash 37. The baseline wash was considered a good performer, although it was only tested on medium coverage print jobs. Due to the addition of the drying step, the use of Wash 37 doubled the time required to wash the blanket (which is proportional to the number of blanket rotations needed), from one, as required with the baseline, to two rotations on average.

Facility 4

Wash 37 was used on a 4-unit, 34" x 40" press at Facility 4 which does most of its business in commercial printing products such as software manuals and calendars. Facility 4 uses a solution of aliphatic hydrocarbons, aromatic hydrocarbons, and surfactants, as the standard blanket wash, according to the MSDS. Blanket wash procedure at Facility 4 consists of a two wipe process. Blanket wash is applied to a clean, dry, and reusable shop towel which is used to wash the blanket. Another clean dry shop towel is then used to remove excess wash and dry the blanket. If ink buildup on the shop towels is not significant, the shop towels are used to wash more than one blanket. If paper coating is deposited on the blanket from the job, the blanket wash shop towel is dipped into a bucket of water before wiping down the blanket. This standard blanket washing procedure was not modified for the performance demonstration.

Initially, Wash 37 performed well at Facility 4. It cut the ink well, soaked into the application shop towel readily, and required little effort. Then, after a few days of usage, Wash 37

caused uncoated paper to stick to the blankets. The tackiness of the blankets was such that uncoated paper stock was pulled apart during the printing process. Facility 4 discontinued its performance demonstration of Wash 37 and the problems disappeared.

Summary of Performance Demonstrations for Blanket Wash 37

Laboratory Testing Results								
Product	**VOC Content (lbs/gal; % by wt)**	**Flashpoint (°F)**	**pH**	**Vapor Pressure (reported, mm Hg)**	**Blanket Swell (%)**		**Washability (# strokes)**	
					1 hour	***5 hour***	***Wet Ink***	***Dry Ink***
WASH 37	1.0; 14%	82	3.9	2.3 @ 68°F	3	3	5	8
Baseline Wash	6.2; 100%	50	6.6	15 @ 100°F	1.5	3	3	8

Field Demonstration Results								
Product/ Facility	**Average Volume Used (ounces)**	**Time required[b] (# rotations)**			**Physical Effort Required (Low, Medium, or High)**			**Performance Evaluation**
		Light Coverage	*Medium Coverage*	*Heavy Coverage*	*Light Coverage*	*Medium Coverage*	*Heavy Coverage*	
WASH 37 at Facility 3	1.3 ± 0.6 (n=17)[a]	2.0 ± 0.0	2.5 ± 0.7	NA	Low	Medium	NA	*Based on a sample size of 17 blanket washes:* • Longer drying time than baseline and standard washes. • Performance rated as good and fair on light and medium coverages, respectively. • Press operators had no problems with wash.
Baseline Wash at Facility 3	1.0 (n=1)	NA	1.0 ± 0.0	NA	NA	Medium	NA	• Good performance: cut the ink well.
WASH 37 at Facility 4	2.2 ± 0.8 (n=6)	NA	2.8 ± 0.4	NA	NA	Medium	NA	*Based on a sample size of 6 blanket washes:* • Worked well initially, but caused paper breakup due to blanket tackiness. • Use of wash discontinued.
Baseline Wash at Facility 4	3.0 ± 0.0 (n=2)	NA	3.0 ± 0.0	NA	NA	Low	NA	• Good performance: cut the ink well. • Slight odor.

NA = Not Applicable; product was not demonstrated under these conditions.

[a] n = number of washes this data is based on, as recorded by the printer.

[b] Time required to clean the blanket measured by the number of blanket rotations. Avg. time per rotation = 24.0 sec. at Facility 3 and 42.0 sec. at Facility 4 (based on time recorded by the project observer)

Blanket Wash 38

Composition:
Hydrocarbons, petroleum distillates
Alkoxylated alcohols
Fatty acid derivatives

VOC Content: 65%; 4.9 lbs/gal
Flashpoint: 230+°F
pH: 5.6

Facility 2

Facility 2 used a 3-unit, 13" x 18" press for the performance demonstrations. This facility prints commercial products (brochures, flyers, cards) using both conventional and vegetable oil-based inks. The standard blanket wash consists of aromatic hydrocarbons, 1,2,4-trimethylbenzene, and aliphatic hydrocarbons (per the MSDS) which, according to the press operator, cuts the ink well, but does have somewhat of an odor. In the past, Facility 2 has tried two substitute blanket washes: performance was rated as poor ("it did not work at all") for one product, and the other product they tested was too expensive. In their standard blanket washing procedure, the press operator at this facility pours the blanket wash onto a reusable rag from a squirt bottle, wipes the ink off the blanket in one rotation, then uses a dry rag for one rotation to remove the excess wash. This procedure was used for both the baseline and the substitute wash.

The use of Wash 38 was discontinued by Facility 2 after 1.5 days of use due to print problems resulting from an oily residue left on the blanket after the blanket wash process. According to press operators, Wash 38 also required more effort to cut the ink and to wipe the blanket than both the standard wash and the baseline wash of the performance demonstration. Performance was especially poor with heavy ink coverage, but Wash 38 was rated as requiring high effort and demonstrating poor performance after every blanket cleaning at Facility 2. The oily film left on the blanket after using Wash 38 caused a noticeable increase in the number of impressions required to reach acceptable print quality after a wash procedure. Press operators experimented with a variety of ways for removing this residue (e.g., dry wipe, water) but were unable to prevent it from affecting print quality.

Facility 4

Wash 38 was used on a 4-unit, 28" x 40" press at Facility 4 with conventional inks to produce a variety of commercial printing products such as software manuals. Facility 4 uses a solution of aliphatic hydrocarbons, aromatic hydrocarbons, and surfactants (according to the information on the MSDS) as the standard blanket wash. Facility 4 has pursued some work practice changes to reduce its use of blanket wash solution. Instead of saturating rags with wash in a plunger can, press operators at Facility 4 are encouraged to apply an appropriate amount of blanket wash on each rag as needed, which reduces the overall quantity of blanket wash used at the facility. Blanket wash procedure at Facility 4 consists of a two wipe process. Blanket wash is applied to a clean, dry, and reusable rag which is then used to wash the blanket. Another clean dry rag is then used to remove excess wash and dry the blanket. If the rags are clean enough, they are used to wash more than one blanket on the 4-unit press. The press blankets rotate automatically during this process. If a significant amount of paper coating is deposited on the blanket from the job, the blanket wash rag is dipped into a bucket of water before wiping down the blanket. This standard blanket washing procedure was not modified for the performance demonstration.

Wash 38 cut the ink well, but left an oily residue on the blanket that increased the number of impressions required to return print quality by 5 to 10 times above that required with the baseline or standard facility washes. Due to this print quality interference, the press operator returned to the standard facility wash after 6 trials. The press operator attempted to remove the oily residue with a dry wipe, but was unable to remove it completely. The oily residue interfered with ink adhesion, especially with red and yellow inks. According to the press operator, Wash 38 cut the ink well but caused sufficient print quality problems to prevent a facility from adopting it for environmental or worker health and safety reasons. The baseline wash was considered a good performer that cut the ink well. Press operators described the odor of the baseline wash as strong.

Summary of Performance Demonstrations for Blanket Wash 38

Laboratory Testing Results								
Product	**VOC Content (lbs/gal; % by wt)**	**Flashpoint (°F)**	**pH**	**Vapor Pressure (reported, mm Hg)**	**Blanket Swell (%)**		**Washability (# strokes)**	
					1 hour	***5 hour***	***Wet Ink***	***Dry Ink***
WASH 38	4.9; 65%	230+	5.6	2.0 @ 68°F	0	1.5	9	16
Baseline Wash	6.2; 100%	50	6.6	15 @ 100°F	1.5	3	3	8

Field Demonstration Results								
Product/ Facility	**Average Volume Used (ounces)**	**Time required[b] (# rotations)**			**Physical Effort Required (Low, Medium, or High)**			**Performance Evaluation**
		Light Coverage	*Medium Coverage*	*Heavy Coverage*	*Light Coverage*	*Medium Coverage*	*Heavy Coverage*	
WASH 38 at Facility 2	2.2± 0.6 (n=9)[a]	3.0 ± 0.0	NA	5.0 ± 0.0	High	NA	High	*Based on a sample size of 9 blanket washes:* • Oily residue caused print quality problems. • Use of wash discontinued after 1.5 days due to poor performance and print quality problems.
Baseline Wash at Facility 2	1.2 ± 0.8 (n=3)	2.7 ± 1.2	NA	NA	Medium	NA	NA	• Wash cut ink satisfactorily. • Did not leave residue on blanket.
WASH 38 at Facility 4	3.7 ± 1.3 (n=6)	NA	3.0 ± 0.0	3.5 ± 0.6	NA	Medium	High	*Based on a sample size of 6 blanket washes:* • Use of wash discontinued after 6 trials due to print quality problems from oily residue. • Wash cut ink satisfactorily.
Baseline Wash at Facility 4	3.0 ± 0.0 (n=2)	NA	3.0 ± 0.0	NA	NA	Low	NA	• Cut the ink well. • Strong odor.

NA = Not Applicable; product was not demonstrated under these conditions.

[a] n = number of washes on which this data is based, as recorded by the printer.

[b] Time required to clean the blanket measured by the number of blanket rotations: Avg. time per rotation = 65.0 sec. at Facility 2 and 45.0 sec. at Fac. 4 (based on time recorded by the observer)

Blanket Wash 39

Composition:
Water
Hydrocarbons, petroleum distillates
Propylene glycol ethers
Alkanolamines
Ethylene glycol ethers

VOC Content: 37%; 2.9 lbs/gal
Flashpoint: 155°F
pH: 9.2

Facility 5

At Facility 5, Wash 39 was used on a single-unit 12" x 18" press, and a single-unit 12" x 18" press with conventional inks and print commercial products such as business cards and advertisements. The press operator at Facility 5 used Wash 39 for most jobs during the one-week demonstration. At this facility, each blanket is typically wiped down two times during cleaning: once with blanket wash to remove the ink, and once with a clean, dry shop towel to remove excess wash. Blanket wash is applied directly to the blanket using a squirt bottle and is then wiped off using a reusable shop towel. The same shop towel is used until it has too much ink build-up to effectively clean the blanket. This application procedure was modified for the baseline wash and substitute wash demonstrations by applying the wash first to the shop towel instead of directly to the blanket. Currently, this facility uses two blanket wash products. According to the MSDSs, one contains aliphatic hydrocarbons, cyclohexane, n-heptane, methylcyclohexane, toluene, C_6-C_8 paraffins, and C_6-C_8 cycloparaffins and the other consists of aromatic hydrocarbons, aliphatic hydrocarbons, 1,2,4-trimethylbenzene, xylene, dipropylene glycol methyl ether, and propylene glycol methyl ether. Facility 5 has tried a variety of substitute blanket washes donated by suppliers. None of these products were adopted either because they did not work as well as their standard wash (left an oily residue on the blanket) or they were too expensive (up to twice as much as their standard wash).

The press operator at Facility 5 evaluated Wash 39 as "good". Although Wash 39 did not dry as fast as the baseline wash, it was found to cut the ink well. The substitute wash was also observed to leave an oily residue on the blanket which required some extra effort to remove with a dry shop towel, but no effect was noticed on the print quality. Wash 39 was tested under light, medium and heavy ink coverage conditions, while the baseline wash was tested under light ink coverage conditions only. Under light coverage conditions, it was observed that Wash 39 required 2.7 rotations to clean the blankets and the baseline wash required 2.0 rotations. The level of physical effort needed to wash the blanket was rated as "medium" for both the substitute wash and the baseline wash. While Wash 39 was found to be effective on the blankets, according to the press operator it could not be used on the rollers. Two products were therefore required to clean up the press, increasing the time and effort needed.

Facility 8

Facility 8 used a 6-unit 20" x 26" press with conventional inks to print brochures, advertisements and other commercial products. The press operator at Facility 8 cleaned five blankets using Wash 39 and then stopped the demonstration because the substitute wash did not cut the ink well and required an unacceptable amount of effort to clean the blankets. At this facility, each blanket is typically wiped down two times during cleaning: once with a reusable shop towel saturated with blanket wash, and once with a clean dry shop towel to remove excess wash.

The saturated shop towel is typically used to clean all six blankets on the press before being resaturated or sent out for laundering. This application procedure was also used for the application of the baseline wash and the substitute wash. Facility 8 was using a wash which, according to the MSDS, contains aliphatic petroleum distillates, aromatic petroleum distillates, xylene, 2-butoxy ethanol, methylene chloride, diacetone alcohol, diisononyl phthalate, 2,6-di-tert-butyl-p-cresol, ethylbenzene and 1,2,4 trimethylbenzene to clean the blankets prior to and following the blanket wash demonstration. Alternative low-VOC blanket washes were experimented with in the past, but they did not cut the ink well, did not dry fast, and left and oily residue on the blanket.

Based on the five blanket cleanings with Wash 39, the press operator at Facility 8 evaluated the performance as "poor". The baseline wash was observed to perform well; cutting the ink well and drying quickly. The operator observed that Wash 39 did not cut the ink well and required a substantial amount of time and effort to get the blankets ready for printing. Wash 39 and the baseline wash were tested under medium ink coverage conditions only. Under these conditions, it was observed that the substitute wash required 6.0 rotations to clean the blanket and only 2.7 rotations using the baseline wash. Because Facility 8 took 17.7 seconds on average to rotate the blanket once, the average increase in blanket cleaning time was about one minute over that of the baseline. Additional time and effort were also needed because the thick consistency of Wash 39 made it difficult to get the wash to soak into the shop towel. The substitute wash left an oily residue on the blanket, but the residue was not observed to have an effect on the print quality. The press operator rated the effort needed to clean the blankets using Wash 39 as "high" primarily due to the extra steps needed to clean the blanket and the difficulty in getting the product to soak into the shop towel. The effort needed to use the baseline wash was also rated as "high" because the operator found it to have unusually high resistance when dragging it across the blanket.

Summary of Performance Demonstrations for Blanket Wash 39

Laboratory Testing Results								
Product	**VOC Content (lbs/gal; % by wt)**	**Flashpoint (°F)**	**pH**	**Vapor Pressure (reported, mm Hg)**	**Blanket Swell (%)**		**Washability (# strokes)**	
					1 hour	***5 hour***	***Wet Ink***	***Dry Ink***
WASH 39	2.9; 37%	155	4.8	0.6 @ 77°F	1.5	3	7	10
Baseline Wash	6.2; 100%	50	6.6	15 @ 100°F	1.5	3	3	8

Field Demonstration Results								
Product/ Facility	**Average Volume Used (ounces)**	**Time required[b] (# rotations)**			**Physical Effort Required (Low, Medium, or High)**			**Performance Evaluation**
		Light Coverage	*Medium Coverage*	*Heavy Coverage*	*Light Coverage*	*Medium Coverage*	*Heavy Coverage*	
WASH 39 at Facility 5	0.7 ± 0.3 (n=32)[a]	2.7 ± 0.5	3.3 ± 0.4	4.2 ± 1.0	Medium	Medium	Medium	*Based on a sample size of 32 blanket washes:* • Good overall performance; cut ink well. • Did not dry as quickly as baseline wash and left an oily residue on the blanket. • Product did not work on rollers.
Baseline Wash at Facility 5	1.0 (n=1)	2.0 ± 0.0	NA	NA	Medium	NA	NA	• Good performance; cut ink well.
WASH 39 at Facility 8	1.0 ± 0.0 (n=5)	NA	6.0 ± 0.0	NA	NA	High	NA	*Based on a sample size of 5 blanket washes:* • Did not cut ink well and therefore required extra time and effort to clean blankets. • Difficult to get wash to soak into shop towel. • Left oily residue on blanket.
Baseline Wash at Facility 8	0.7 ± 0.0 (n=4)	NA	2.7 ± 0.5	NA	NA	High	NA	• Cut ink well. • Extra effort was required due to resistance to being dragged across the blanket.

NA = Not Applicable; product was not demonstrated under these conditions.

[a] n = number of washes on which this data is based, as recorded by the printer.

[b] Time required to clean the blanket measured by the number of blanket rotations. Avg. time per rotation = 15.4 sec. at Facility 5 and 17.7 sec. at Facility 8 (based on time recorded by the observer)

Blanket Wash 40

Composition:
Hydrocarbons, aromatic
Hydrocarbons, petroleum distillates
Fatty acid derivatives
Ethoxylated nonylphenol

VOC Content: 52%; 3.8 lbs/gal
Flashpoint: 155°F
pH: 4.8

Facility 1

At Facility 1, performance demonstrations were conducted on an eight-unit, 28" x 40" press using vegetable-based inks to print high quality, multi-color, commercial products. Currently, Facility 1 uses a blanket wash which consists of aromatic hydrocarbons, 1,2,4-trimethylbenzene, and aliphatic hydrocarbons as their standard wash, according to the MSDS. In the months preceding the demonstrations, the facility had tried two different low-VOC blanket washes; neither worked as well as their standard wash. At this facility, each blanket is typically wiped down twice during cleaning: once with a reusable shop towel saturated in blanket wash to remove the ink, and once with a dry shop towel to remove excess blanket wash. Each saturated shop towel is used to clean two blankets. The same application procedure was used for the baseline and substitute products. The quantity of wash needed to saturate the shop towel and clean the blanket remained constant throughout the demonstration, regardless of the ink coverage or ink build-up on the blanket. There were both positive and negative aspects to this application method. While more wash than was needed may have been used in some cases, the consistency of the application volume made it possible to compare the performance of the standard, baseline, and substitute products under the same conditions.

Overall, the performance of Wash 40 was considered "good" when ink coverage was medium, and "good/fair" for heavy ink coverage; no information was recorded on the performance of Wash 40 on a blanket with light ink coverage. The facility used Wash 40 for one week, but recorded information on only 6 washes. The press operator who usually completed the forms was out of the facility for several days, during which time forms were not completed although the product was used. Following the manufacturer's instructions, Facility 1 diluted one part wash with one part water. When used at the diluted concentration, Wash 40 left a greasy residue on the blanket. It usually took two rotations of the blanket while wiping with a dry shop towel to remove this residue. Because of this extra effort, the press operator stopped diluting the wash and tried using it at full strength. At full strength, residue was no longer a problem. Blankets with medium ink coverage on average required one rotation to clean, one rotation to dry, and low effort. When the ink coverage was heavy, the effort increased and three or four rotations and medium effort were needed to clean the blanket. The performance of Wash 40 was comparable to the baseline wash performance. The operator found the baseline wash cut the ink well, but required slightly more effort than their standard wash. As with Wash 40, two blanket rotations were needed to clean the blanket when ink coverage was light or medium; the baseline was not used on a blanket with heavy ink coverage. Since blanket rotation is automatic, each rotation consistently took 20 seconds, resulting in an average cleaning time when using Wash 40 of 40 seconds (2 rotations) for medium ink coverage, and 80 seconds (4 rotations) for heavy ink coverage. The press operator found that Wash 40 was easier to apply when the blanket was wiped with a sponge wet with water prior to application of the blanket wash. In this facility's standard practice, a wet sponge is occasionally used to wipe any paper or particles from the blanket before applying a blanket wash, so this extra

step was not seen as particularly burdensome. At all levels of ink coverage, no print quality problems attributable to Wash 40 were experienced.

Facility 10

At Facility 10, Wash 40 was demonstrated on a six-unit, 19" x 28" press using conventional inks to print primarily commercial products, such as brochures, cards, and posters. Currently, Facility 10 uses a naphtha blend as their standard wash, according to the MSDS. They have tried a few alternative washes, but found that they either did not work as well, or that they cost more than twice as much as their standard blanket wash. Typically, this facility uses the following procedure to clean the blanket: wipe the blanket with a water-soaked sponge to remove built up paper and particles (1 - 2 rotations); pour blanket wash onto a reusable shop towel from a squeeze bottle; wipe blanket with product (2 rotations); wipe off excess with a clean, dry shop towel (1 - 2 rotations). Both the baseline product and Wash 40 were applied using the same procedure.

Facility 10 used Wash 40 for one week, recording data for 20 blankets, and the performance was evaluated as "good" Although the manufacturer's instructions indicated that Wash 40 could be diluted with up to 50 percent water, the press operator preferred to try it at full strength first, and if successful, he would dilute the product. At full strength, the wash cut the ink well. Only one blanket with heavy ink coverage was cleaned with Wash 40 during the demonstrations. On this blanket with heavy coverage, the operator found some extra effort was required (4 blanket rotations instead of the 3 rotations required for light and medium coverage, and medium effort instead of the low effort reported for light and medium coverage). Because of this additional effort for heavy ink coverage, the printer felt that the diluted wash would not perform well and he only used Wash 40 at full strength. He did, however, pour the wash onto a shop towel that was slightly dampened with water, instead of a dry shop towel. According to the press operator, the performance of Wash 40 was comparable to the performance of the baseline wash. The operator found the baseline product worked as well, with the same effort required and ability to cut the heavy ink coverage as their standard product, but the odor was strong. There were no problems with print quality attributable to the wash, and there was no odor noticed when using this blanket wash.

Summary of Performance Demonstrations for Blanket Wash 40

Laboratory Testing Results								
Product	**VOC Content (lbs/gal; % by wt)**	**Flashpoint (°F)**	**pH**	**Vapor Pressure (reported, mm Hg)**	**Blanket Swell (%)**		**Washability (# strokes)**	
					1 hour	***5 hour***	***Wet Ink***	***Dry Ink***
WASH 40	3.8; 52%	155	4.8	4.7 @ 77°F	1.5	3	5	10
Baseline Wash	6.2; 100%	50	6.6	15 @ 100°F	1.5	3	3	8

Field Demonstration Results							
Product/ Facility	**Average Volume Used (ounces)**	**Time required[b] (# rotations)**			**Physical Effort Required (Low, Medium, or High)**			**Performance Evaluation**
		Light Coverage	*Medium Coverage*	*Heavy Coverage*	*Light Coverage*	*Medium Coverage*	*Heavy Coverage*	
WASH 40 at Facility 1	2.5 ± 0.0 (n=6)[a]	NA	2.0 ± 0.0	3.7 ± 0.6	NA	Low	Medium	*Based on a sample size of 6 blanket washes:* • Good performance. • When diluted with water, left residue. No residue problem at full strength.
Baseline Wash at Facility 1	2.5 ± 0.0 (n=2)	2.0 ± 0.0	2.0 ± 0.0	NA	High	High	NA	• Good performance. • Required slightly more effort than standard wash to remove the excess wash.
WASH 40 at Facility 10	0.9 ± 0.2 (n=20)	3.0 ± 0.0	3.0 ± 0.0	4.0 ± 0.0	Low	Medium	Medium	*Based on a sample size of 20 blanket washes:* • Good performance; cut ink well. • Required slightly more effort when coverage was heavy.
Baseline Wash at Facility 10	1.5 ± 0.0 (n=2)	NA	NA	5.0 ± 0.0	NA	NA	Medium	• Good performance; cut heavy ink well. • Operator noticed a strong odor.

NA = Not Applicable; product was not demonstrated under these conditions.

[a] n = number of washes on which this data is based, as recorded by the printer.

[b] Time required to clean the blanket measured by the number of blanket rotations: Avg. time per rotation = 20.0 sec at Facility 1 and 11.2 sec at Facility 10 (as measured by the observer)

4.2 BLANKET WASH COST ANALYSIS METHODOLOGY

The methodology described below was used to estimate the cost of using the baseline blanket wash as well as the cost of using 22 substitute blanket washes. The primary source of information for the cost estimates was the performance demonstration conducted during production runs at 17 volunteer facilities in late 1994 and early 1995 and described in section 4.1. This information was supplemented by several other sources, including: 1) industry statistics collected by trade groups such as NAPL; 2) lease prices for cloth printer's wipes from a large east coast industrial laundry; and 3) EPA's risk assessment work presented in chapter 3.

The performance demonstration collected data on the use of donated, substitute blanket wash products and the baseline, VM&P Naphtha. Substitute products were screened for blanket swell and washability; each was then sent to two printing facilities. Each facility also tested the baseline product; results are presented comparing the substitute products to the baseline. Although each facility was to use the substitute product for one week, performance problems and scheduling conflicts resulted in some products being used more than others. Section 4.1.4 provides a discussion of the limitations of the demonstration. Table 4-2 in the previous section summarizes the results.

Certain assumptions were used in this analysis to smooth out the differences among the various facilities participating in the performance demonstration in order to make the results comparable and to remain consistent with assumptions used in other parts of this CTSA. For example, it was assumed that there are four blankets or "units" per press, each of which is washed 10 times per shift. Additionally, it was assumed that work is performed for one 8-hour shift per day, 5 days per week, 50 weeks per year. Using these assumptions, the following costs were estimated for individual facilities involved in the performance demonstrations for the baseline blanket wash and each substitute blanket wash:

- Total cost/wash,
- Total cost/press, and
- Total cost/press/shift/year.

A general description of the cost estimation methodology and data sources used is presented in Section 4.2.1 below. Section 4.2.2 provides a more detailed description of the methodology. Section 4.2.3 provides an example of the calculations described in Sections 4.2.1 and 4.2.2.

4.2.1 General Description of Costing Methodology

In general, the cost estimate for each reclamation method combines product cost and product performance data. Variations in the sample sizes, the value for 'n', found in the labor rate (time), the number of wipes per cleaning, quantity of wash used and number of cleanings used to determine performance are due to differences in the way the data for each factor was collected. For example, in the case of the time required to clean the blanket, only the data collected by the observer on the first day of the demonstration were used in the assessment. In determining the average quantity of blanket wash used, data collected during the entire week were utilized in the assessment resulting in a higher sample size. The final cost estimates are a combination of the three distinct cost elements listed below:

Labor

The time spent to clean the blanket was recorded in the performance demonstrations by the observer on the first day of the demonstration for each product, as it was not feasible for press operators to time themselves while cleaning. Therefore, estimates of time to clean the blanket

recorded by observers were used to calculate the labor cost.[a] The labor cost was calculated as the total time spent multiplied by 1) the average wage rate for lithography press operators of $15.52/hour, 2) an industry fringe rate (to account for holiday and vacation) of 1.07, and 3) an industry multiplier of 1.99 to account for overhead costs. All of these cost elements were calculated from industry statistics reported in NAPL's *1993 Cost Study* and are explained in more detail in Section 4.2.2.

Cost Methodology Information Basis Summary

Labor
- Observer time from demonstration
- Wage rate - $15.52/hr
- Fringe rate multiplier - 1.07
- Overhead rate multiplier - 1.99

Blanket Wash
- Recorded quantity used during demonstration
- Adjusted for dilution
- Product cost provided by supplier

Materials - Wipes
- Recorded quantity used during demonstration
- Lease price - $0.11/wipe

Blanket wash products

The quantity of blanket wash used per blanket was recorded during the observer's visit and by the press operator during the week of demonstrations. Average usage per blanket was calculated at each facility for both the baseline product and the 22 substitute products. Multiplying usage per wash, accounting for dilution where necessary, by the unit cost of each product (provided by each participating manufacturer and summarized in Table 4-3) yielded the blanket wash costs.

Materials (i.e., wipes)

The only materials consumed in manual blanket washing are the wipes used by the press operator to wash the blanket. All but one of the print shops participating in the performance demonstration used cloth wipes; the other used disposable wipes. Materials costs were therefore calculated by multiplying the number of wipes used, as recorded in the performance demonstrations, by the lease price of a cloth printer's wipe. (A representative of Standard Uniform Services, one of the largest industrial laundries in Massachusetts, provided an estimated lease price of $0.11 per wipe.)

[a] *An alternative method of determining the labor time was examined, apart from using the average time estimates compiled by observers. Within each facility, observers and press operators collected data on the number of blanket rotations per wash. Because only observers compiled time estimates, the rotations data included more observations and was, therefore, considered as an alternative method for estimating labor time. However, this approach was abandoned after further analysis found poor correlation between time and number of rotations. Although occasionally high correlation was found to exist, the majority of facilities did not show a high degree of correlation. Eight facilities with the greatest number of observations were analyzed separately to determine if time and number of rotations were correlated. Again, poor correlation was found. This is interpreted to mean that there was not a preset cleaning speed for the rotation of the cylinders; we were not, therefore, able to use the number of rotations multiplied by the average time per rotation recorded by the observer to determine the labor time involved with cleaning the cylinders. In addition, the ink coverage changed from one cleaning to the next, adding a variation which affected the cleaning time. However, poor correlation between time and number of rotations was also found to exist for facilities that reported consistent ink coverage.*

The trend in the number of rotations necessary to clean a cylinder was also examined to determine if there was a learning curve involved with using the alternative cleaners. While it is believed that there is a learning curve, the demonstration timetable was too short for this observation, which was further complicated by variable ink coverage.

A summary of the cost comparisons is presented in Table 4-4, followed by a graphical display (Figure 4.1) of the relative cost changes (substitute compared to baseline) at each facility.[b] Figure 4.1 illustrates the range of percentage cost changes (compared to the baseline) measured at each facility. Two points are plotted for each of the substitute products because each was tested at two facilities. Formulations are arranged by ascending VOC content. Cost comparisons for each blanket wash against the baseline are provided at the end of this section; summary paragraphs are followed by tables providing specific results. Absolute and relative cost variations are reported for each substitute. An increase in the time required to clean the blanket, quantity of wash solution used, number of wipes expended, and costs of labor and materials is preceded by a plus sign; conversely, decreases are denoted by a minus sign.

Table 4-3. Substitute Blanket Washes, Manufacturer Pricing

Blanket Wash Number and Type	Product Cost per Gallon ($)** (based on the 55 gallon drum price)($)
Baseline - VM&P Naphtha	5.88
1 - Vegetable Fatty Ester	20.00
6 - Ester/Petroleum + Surfactant	12.35
9 - Ester/Water	10.26
10 - Ester/Water	9.55
11 - Ester/Petroleum + Surfactant	12.15
12 - Petroleum/Water Diluted for Use	16.40
14 - Vegetable Fatty Ester + Glycol	9.55
19 - Vegetable Fatty Ester + Glycol	11.80
20 - Petroleum/Water	10.80
21 - Ester/Petroleum	10.08
22 - Water/Petroleum/Ester	13.15
24 - Terpene	17.85
26 - Vegetable Fatty Ester	12.24
29 - Vegetable Fatty Ester	18.00
30 - Petroleum/Water Diluted for Use	5.00
31 - Petroleum	9.80
32 - Petroleum	2.85
34 - Water/Petroleum/Ester	15.00
37 - Petroleum/Water	14.80
38 - Ester/Petroleum	19.00
39 - Petroleum/Water	8.95
40 - Ester/Petroleum + Surfactant	10.25

** Unit costs supplied by manufacturers participating in the performance demonstrations.

[b]*Products 9, 22, and 32 are not included within Figure 4.1 because VOC content for these products was not available.*

Table 4-4. Summary of Cost Analysis for Blanket Wash Performance Demonstration

Formula Number	Test Facility	Total cost/wash		Total cost/press		Total cost/press/shift/year		Percentage Difference[1]
		Baseline	Alternative	Baseline	Alternative	Baseline	Alternative	
1	Facility 3	0.55	0.69	2.20	2.76	5,500	6,900	+25
	Facility 6	0.46	0.87	1.84	3.48	4,600	8,700	+89
6	Facility 11	0.70	0.82	2.80	3.28	7,000	8,200	+17
	Facility 15	0.50	0.77	2.00	3.08	5,000	7,700	+54
9	Facility 10	0.91	2.08	3.64	8.32	9,100	20,800	+129
	Facility 15	0.50	0.92	2.00	3.68	5,000	9,200	+84
10	Facility 3	0.55	0.57	2.20	2.28	5,500	5,700	+4
	Facility 4	0.85	2.20	3.40	8.80	8,500	22,000	+159
11	Facility 1	0.59	1.29	2.36	5.16	5,900	12,900	+119
	Facility 2	0.53	0.68	2.12	2.72	5,300	6,800	+28
12	Facility 12	0.81	0.99	3.24	3.96	8,100	9,900	+22
	Facility 13	0.80	0.83	3.20	3.32	8,000	8,300	+4
14	Facility 6	0.46	1.07	1.84	4.28	4,600	10,700	+133
	Facility 16	0.66	0.82	2.64	3.28	6,600	8,200	+24
19	Facility 18	0.62	1.66	2.48	6.64	6,200	16,600	+168
	Facility 19	0.53	0.89	2.12	3.56	5,300	8,900	+68
20	Facility 11	0.70	1.13	2.80	4.52	7,000	11,300	+61
	Facility 12	0.81	1.58	3.24	6.32	8,100	15,800	+95

Formula Number	Test Facility	Total cost/wash		Total cost/press		Total cost/press/shift/year		Percentage Difference[1]
		Baseline	Alternative	Baseline	Alternative	Baseline	Alternative	
21	Facility 6	0.46	1.01	1.84	4.04	4,600	10,100	+120
	Facility 17	0.41	0.58	1.64	2.32	4,100	5,800	+41
22	Facility 12	0.81	0.82	3.24	3.28	8,100	8,200	+1
	Facility 13	0.80	1.51	3.20	6.04	8,000	15,100	+89
24	Facility 16	0.66	0.97	2.64	3.88	6,600	9,700	+47
	Facility 17	0.41	0.88	1.64	3.52	4,100	8,800	+115
26	Facility 5	0.55	0.73	2.20	2.92	5,500	7,300	+33
	Facility 15	0.50	0.47	2.00	1.88	5,000	4,700	-6
29	Facility 7	0.57	0.93	2.28	3.72	5,700	9,300	+63
	Facility 8	0.55	0.89	2.20	3.56	5,500	8,900	+62
30	Facility 18	0.62	1.01	2.48	4.04	6,200	10,100	+63
	Facility 19	0.53	0.62	2.12	2.48	5,300	6,200	+17
31	Facility 7	0.57	1.59	2.28	6.36	5,700	15,900	+179
	Facility 8	0.55	0.59	2.20	2.36	5,500	5,900	+7
32	Facility 1	0.59	1.31	2.36	5.24	5,900	13,100	+122
	Facility 5	0.53	0.43	2.12	1.72	5,300	4,300	-19
34	Facility 1	0.59	0.89	2.36	3.56	5,900	8,900	+51
	Facility 19	0.53	0.95	2.12	3.80	5,300	9,500	+79

Formula Number	Test Facility	Total cost/wash		Total cost/press		Total cost/press/shift/year		Percentage Difference[1]
		Baseline	Alternative	Baseline	Alternative	Baseline	Alternative	
37	Facility 3	0.55	0.48	2.20	1.92	5,500	4,800	-13
	Facility 4	0.85	0.79	3.40	3.16	8,500	7,900	-7
38	Facility 2	0.53	1.08	2.12	4.32	5,300	10,800	+104
	Facility 4	0.85	1.11	3.40	4.44	8,500	11,100	+31
39	Facility 5	0.55	0.69	2.20	2.76	5,500	6,900	+25
	Facility 8	0.55	0.80	2.20	3.20	5,500	8,000	+45
40	Facility 1	0.59	0.79	2.36	3.16	5,900	7,900	+34
	Facility 10	0.91	0.87	3.64	3.48	9,100	8,700	-4

[1] A positive sign denotes an increase and a negative sign denotes a decrease in the cost when using the alternative blanket cleaner instead of the base product.

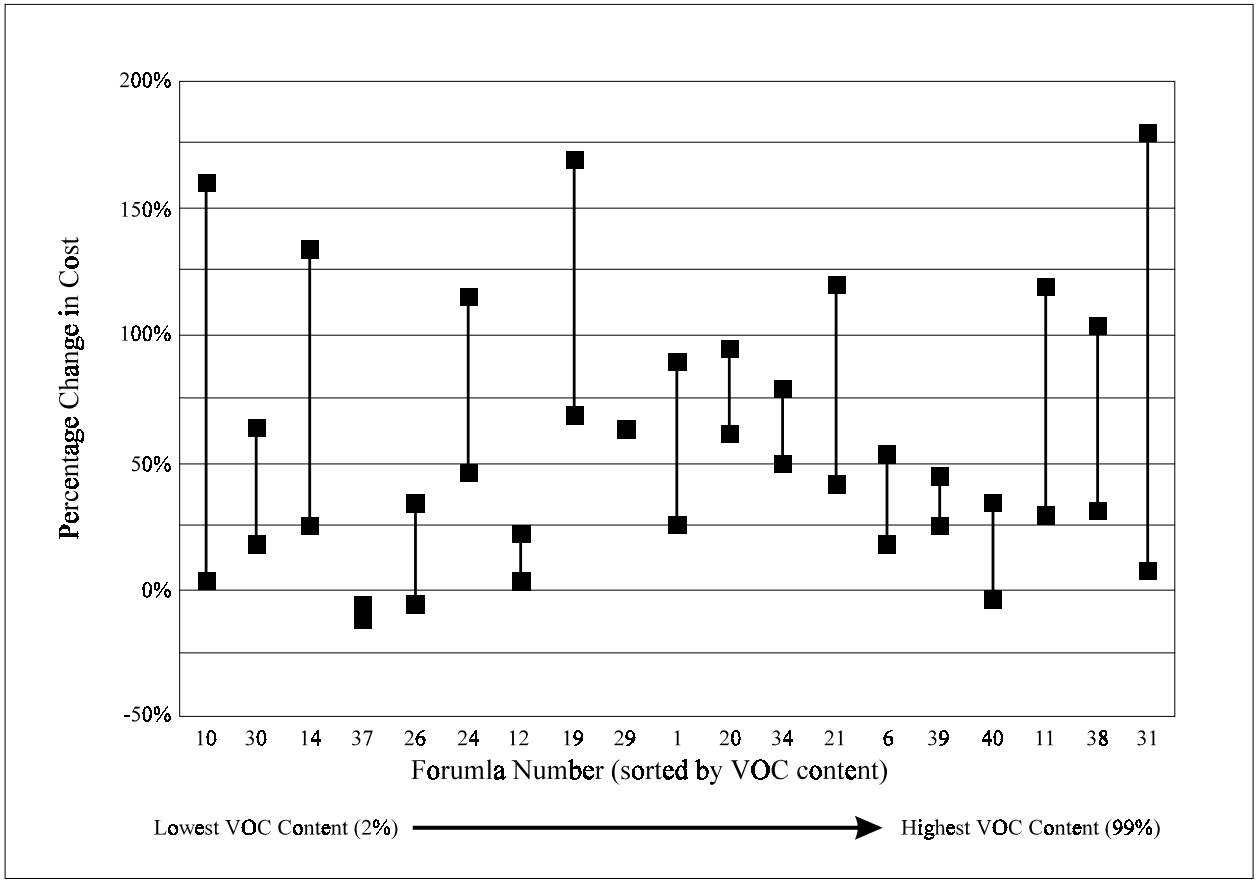


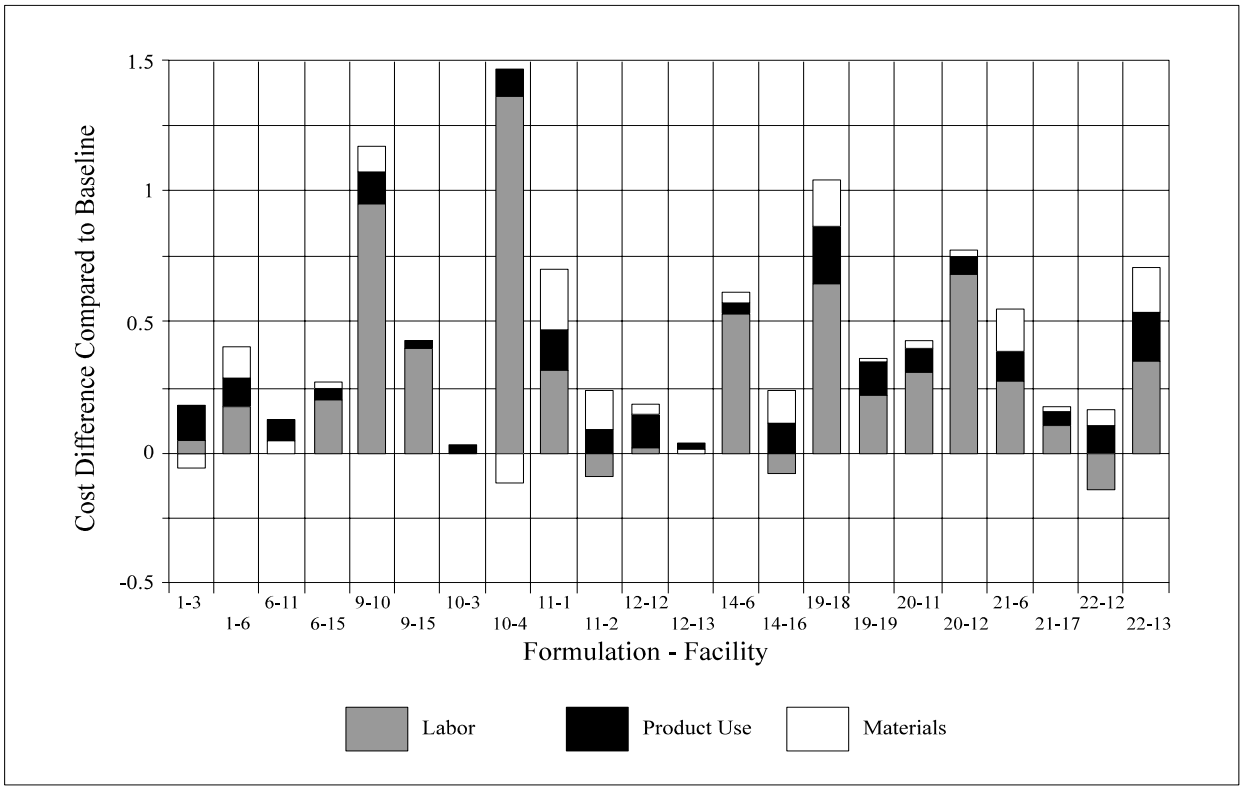
Figure 4.1 Blanket Wash Costs Changes Arranged by Lowest to Highest VOC Content of Formulations

4.2.2 Details Related to Data Sources and Methodological Approach

As mentioned above, the blanket wash cost comparison considered three cost elements when comparing the performance of baseline and substitute blanket cleaners: labor costs (time × wage rate); blanket wash use (quantity × unit price), adjusting for dilution; and material and equipment costs (# wipes × cost per wipe). Each element is described in more detail below. Also, Figure 4.2 presents a graphical display of the relative contribution of labor, product use, and material use to the overall cost differences (compared to the baseline) for each of the substitute products. For example, performance results for product 1, tested at facility 6 indicate that overall costs per wash were $0.41 greater for Blanket Wash 6 compared to the baseline. The $0.41 difference is divided up as follows: costs associated with labor were $0.19 higher than the baseline, costs associated with product use (i.e., price x quantity) were $0.11 greater than the baseline, and costs associated with material and equipment use were $0.11 greater than the baseline.

Labor Costs

The hourly wage and overhead rate for press operators was calculated from the *NAPL 1993 Cost Study*. The NAPL study presents a number of facility-specific characteristics, including



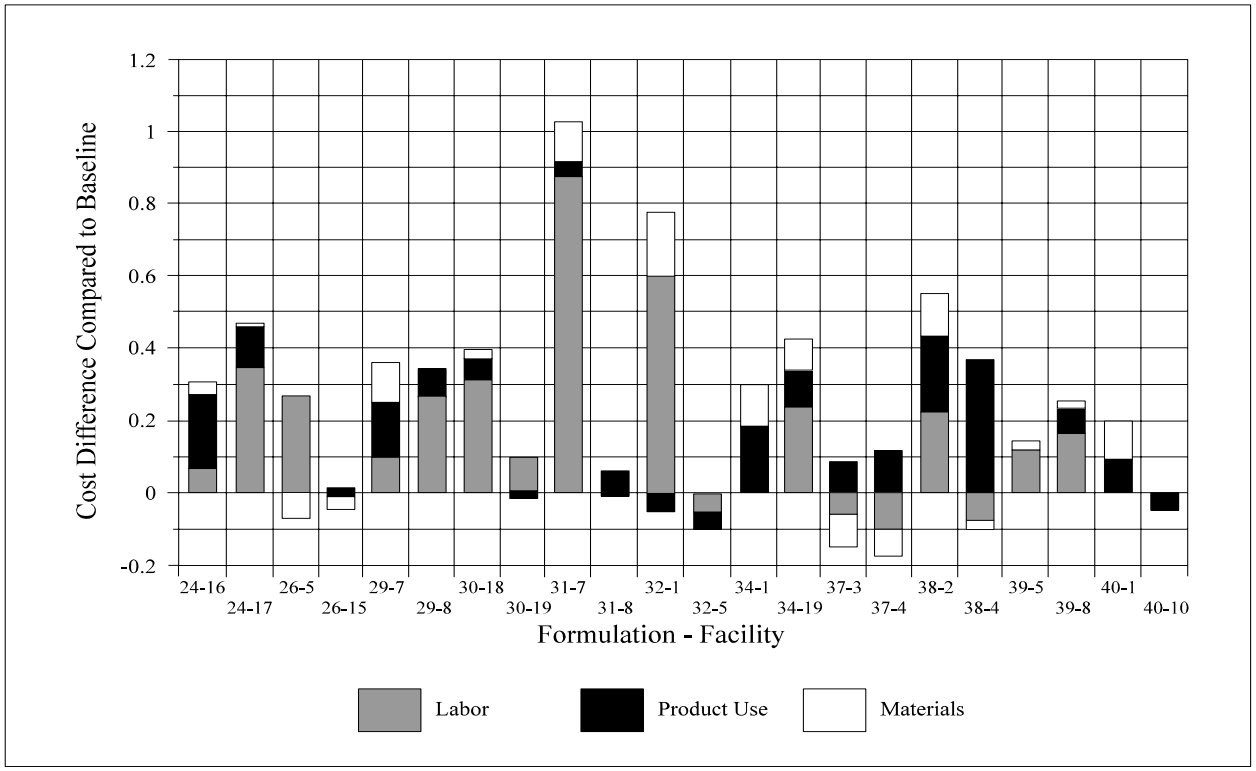


Figure 4.2 Cost Difference Between Substitute and Baseline Blanket Washes

annual wages and overhead costs by press type and brand, number of shifts per day, length of work week, and vacations and holidays allowed. Because of the many variables impacting hourly wages and overhead rates, several assumptions were made to facilitate comparisons along the various alternatives.

Assumptions

- Based on a review of press sizes used in the performance demonstrations as well as discussions with performance demonstration observers, wage rates and overhead expenses for a 26-inch, 2-unit press were used in this analysis.

- The *NAPL 1993 Cost Study* presents three possible employment scenarios (referred to as areas A, B, and C), each with differing wages and overhead costs. The "areas" are defined as follows: 1) area A: 35 hours/week, 4 weeks paid vacation, and 11 paid holidays; 2) area B: 37.5 hours/week, 3 weeks paid vacation, and 10 paid holidays; and 3) area C: 40 hours/week, 2 weeks paid vacation, and 8 paid holidays. It was assumed that press operations at performance demonstrations shops operate under a 40 hour work week and are offered 2 weeks paid vacation and 8 paid holidays per year.

- Annual wages and overhead rates vary according to the number of (eight hour) shifts the press facility operates per day. As the number of shifts increase, the wage rate for all shifts increases and the overhead rate decreases. To estimate average wage and overhead rates for this analysis, hourly wage estimates and overhead rates were weighted according to the proportion of facilities participating in performance demonstrations operating one, two or three shifts per day.

- The NAPL cost study provides overhead expenses for seven brands of presses within the 26-inch, 2-unit press category. Overhead rates were calculated by averaging across the seven brands. Annual wages do not vary across the seven brands of presses.

Hourly wage rate for a press operator

As mentioned above, annual wage rates, presented in the NAPL cost study, do not vary across press type; however, wages do vary according to the number of shifts operated per day. In this analysis, a weighted average of $15.52/hour was calculated given that nine of the facilities that participated in the performance demonstration operate one shift per day, four facilities operate two shifts per day, and four facilities operate three shifts per day. Calculations of the average hourly wage are presented in Table 4-5 below.

Table 4-5. Calculation of Average Hourly Rate

# Shifts (8 hrs.)	Annual Wage	Hourly Wage	Weight (Facilities × shifts)	Wage × Weight
1	$31,200	$15.00	9	$135
2	$64,740	$15.56	8	$124
3	$99,060	$15.88	12	$191
Totals:			29	$450
Total wage × weight:				$450.04
Total/29:				**$15.52**
Source: NAPL 1993 Cost Study				

Fringe rate

To account for costs associated with fringe benefits such as holiday and vacation time, a fringe rate was calculated. The NAPL Cost Study indicates that press operators working a 40 hour week receive eight paid holidays and two weeks vacation per year. To calculate the fringe rate, non-productive hours were subtracted from total hours of operation per year (i.e., 2,080 hours minus 144 hours = 1936 hours). The ratio of total hours to productive hours is equal to the fringe rate applied to each hour worked (2080/1936 = 1.074).

Overhead rate

Overhead rates for this analysis are calculated according to the following formula[c]:

$$\frac{\text{depreciation + rent \& heat + fire \& sprinkler insurance + pension fund + welfare benefits + payroll taxes + workmen's comp. + light \& power + direct supplies + repairs to equipment + general factory + administrative \& selling overhead}}{\text{direct labor + supervisory and misc. labor}}$$

The NAPL cost study provides overhead expenses for seven brands of presses within the 26-inch, 2-unit press category. For the purposes of this analysis, overhead rates were averaged across the seven brands. As with the hourly wage calculations, a weighted average was calculated, accounting for the variability in the number of shifts a facility may operate per day. The overhead rate was estimated to be 1.99.

Total Labor Cost

The total labor cost associated with the use of an individual blanket wash was calculated by multiplying the average cleaning time by the press operator's hourly wage, overhead rate, and fringe rate. For example, the total labor cost for Blanket Wash 1, tested by facility 3, was calculated by multiplying the average time spent cleaning (37.5 seconds) by the wage per second ($15.52/60min/60sec[d]), overhead rate (1.99), and fringe rate (1.074) for a total cost of $0.35 per wash.

Blanket Wash Use

Costs attributable to blanket wash use were calculated by multiplying the average quantity of blanket cleaner used per wash cycle by the price of the appropriate wash. In cases where participants diluted blanket wash with water, the unit price was multiplied by the ratio of cleaner used and not the total quantity of the mixture. For example, if the dilution ratio was 1:1, the unit price of the blanket wash was multiplied by 0.5 to account for dilution and then multiplied by the volume used. As mentioned above, blanket wash prices were provided by manufacturers participating in the performance demonstrations. During the performance demonstrations it was observed that most printing facilities purchased blanket cleaner in 55-gallon quantities. This was assumed to be true of all printing facilities participating in the performance demonstration.

Material and Equipment Costs

Because the performance demonstrations were limited to manual blanket washing, the only materials or equipment affecting the cost of blanket washing were the wipes used by the press operator to remove ink and paper products. The cost of press wipes were calculated by multiplying

[c] *Overhead cost elements were taken directly from the NAPL 1993 Cost Study.*

[d] *The wage rate of $15.52 per hour translates to $0.0043 per second.*

the average number of wipes used per wash by the lease price of a cloth printer's wipe. A representative of Standard Uniform Services, one of the largest industrial laundries in Massachusetts, estimated a lease price of $0.11 per wipe.

Waste Disposal

Because blanket washing wastes may be classified as hazardous wastes by regulations implementing RCRA and therefore require more careful and costly handling and disposal, printers may reduce waste disposal costs if wastes associated with alternative blanket washes do not contain any RCRA listed wastes, eliminating the need to be handled as hazardous waste.[e] Disposal costs were not considered in this cost comparison, however, because all but one of the printers participating in the performance demonstrations use cloth wipes that are leased from an industrial laundry. Industrial laundries currently do not distinguish between hazardous and nonhazardous blanket washes when laundering wipes; it was therefore assumed that there would be no savings in waste handling or processing costs associated with switching to an alternative blanket wash product. In addition, the impact of alternative cleaners on the costs of handling and processing used wipes is unclear. For example, according to the Uniform and Textile Service Association, wipes impregnated with vegetable-oil based cleaners have a higher potential for spontaneous combustion when piled together in a laundry bag. Vegetable-oil based cleaners break down, creating exothermic heat and the potential for spontaneous combustion. In addition, the vegetable oil-based cleaners may make wastewater treatment and permit compliance more difficult for the industrial laundry (Dunlap, 1995).

While there is a potential for reduction in waste treatment and disposal costs attributed to the use of alternative blanket cleaners, the current state of federal regulations is in flux. Also, there are many different state and local regulations which might dictate different treatment for hazardous blanket wash wastes. Specifically, future changes to RCRA and the Clean Water Act (CWA) could potentially create a cost advantage for printers using alternative blanket cleaners. Currently, under RCRA, the mixture rule classifies a non-hazardous waste as hazardous when combined with a listed waste (F, P, K, and U listed wastes). The mixture rule was struck down by a 1991 District of Columbia Circuit Court ruling, but was temporarily reenacted while EPA conducts a review of the rule. EPA has not provided definitive guidance on the treatment of solvent contaminated shop towels, leaving it to each state to provide guidance on the identification and management of press wipes.[f] Many states have responded by recognizing a conditional exemption from the mixture rule for contaminated press wipes. EPA's Office of Solid Waste is currently considering changes to the definition of hazardous and solid wastes that could potentially exempt press wipes from hazardous waste classification. Also, EPA is currently developing categorical standards for the industrial laundry industry that could potentially impact the cost of treating press wipes.

The results of the cost comparisons are presented in section 4.2.4 in both cost summary tables and descriptive paragraphs (for each of the 22 field tested blanket washes). As indicated in the tables, presses of three *standard* sizes were used in the performance demonstrations:

- 19" × 26" -- also recorded by printers as 18" × 25", 19" x 25", 19" x 28", and 20" x 26";
- 11" × 17" -- also recorded by printers as 13" × 18", and 12" × 18"; and
- 40" × 28" -- also recorded by printers as 40" × 34."

[e] *Costs of managing hazardous wastes include placing the waste in a closed and properly labeled container, manifesting shipments and using special shipping arrangements, and shipping to a permitted hazardous waste treatment or disposal facility.*

[f] *The EPA is planning to develop guidance to the States for the use, reuse, transportation, and disposal of shop towels.*

Additionally, ink coverage is reported in the tables as the *average* ink coverage observed on the blanket throughout the demonstrations. Coverage is reported as light, light-medium, medium, medium-heavy, and heavy. Cost savings or increases (absolute and percent differences) associated with using each of the alternatives as compared to the baseline (VM&P Naphtha) are indicated for each facility. A positive sign denotes an increase and a negative sign denotes a decrease in the time, quantity, number of wipes, or cost when using the alternative blanket cleaner instead of the base product.

4.2.3 Example Calculation

As an example of the cost calculations presented in the cost summary tables, the calculations for alternative Blanket Wash 1, tested by facility 3, are described in full. Total labor cost was calculated by multiplying the average time spent cleaning (37.5 seconds) by the wage per second ($15.52/60min./60sec.), overhead rate (1.99), and fringe rate (1.074) for a total cost of $0.35 per wash. The cost associated with blanket wash use was calculated by multiplying the average quantity used per wash (1.04 ounces or 8.13×10^{-3} gallons) by the unit price of Blanket Wash 1 ($20.00/gallon) for a total cost of $0.16 per wash. The material cost was calculated by multiplying the average number of wipes used per wash (1.6 wipes) by the estimated lease cost per wipe ($0.11/wipe). The total cost per wash for Blanket Wash 1 ($0.69) is simply the sum of the labor, blanket wash, and material costs and is presented at the bottom of the cost summary table for Blanket Wash 1.

Labor Cost
=average cleaning time/wash × wage rate × overhead rate × fringe rate
=37.5 sec × ($15.52/hr × 1hr/60min × 1min/60sec) × 1.99 × 1.074
=$0.35 per wash

Blanket Wash Cost
=average quantity used/wash × unit price of blanket wash
=(8.13×10^{-3} gallons) × $20.00/gallon
=$0.16 per wash

Material Cost
=average number of wipes used/wash × lease cost/wipe
=1.6 wipes × $0.11/wipe
=$0.18 per wash

Total Cost per Wash
=labor cost + blanket wash cost + material cost
=$0.35 + $0.16 + $0.18
=$0.69 per wash

Also presented at the bottom of each table are estimates of total cost per press and total annual costs. The total cost per press ($2.76) for Blanket Wash 1, tested at facility 3, is calculated by multiplying the total cost per wash ($0.69) by the estimated number of blankets per press (4 blankets). The total annual cost ($6,900) is calculated by multiplying the total cost per press ($2.76) by the number of washes per shift (10 washes), the number of shifts per week (5 shifts), and the number of weeks worked per year (50 weeks):

Total Cost per Press

=cost/wash × estimated number of blankets/press
=$0.69 × 4 blankets
=$2.76

Total Annual Cost

=total cost/press × number of washes/shift × number of shifts/week × number of weeks/year
=$2.76/press × 10 washes/shift × 5 shifts/week × 50 weeks/year
=$6,900

Costs of using the baseline product were calculated according to the same procedure used for the alternative blanket washes. The absolute and percentage difference between the costs of the baseline product and Blanket Wash 1 are presented in the cost summary table for Blanket Wash 1. For example, the absolute difference between the labor cost for the baseline product and Blanket Wash 1 is +$0.07 ($0.35 minus $0.28). The positive sign indicates an increased labor cost when using Blanket Wash 1 instead of the baseline (VM&P Naphtha). Labor costs associated with the use of Blanket Wash 1 increase 25% based upon the experience of facility 3. In contrast, the cost associated with material and equipment use for Blanket Wash 1 decreased by four cents or 18%.

4.2.4 Blanket Wash Cost Analysis Results

The results of the cost analysis are summarized in the following paragraphs and tables. It is important to keep in mind several factors when reviewing these results. First, they are based almost entirely on the results of the performance demonstration. For each individual product, the performance demonstrations were subjective assessments reflecting the conditions and experiences of two individual print shops, not scientifically rigorous evaluations. As such, the information derived from the demonstrations are illustrative and are not necessarily reflective of the actual experience of using the various products at a particular facility. The two facilities which tested each product often had very different experiences. As described in the introduction to Section 4.1 - Performance Demonstration, reasons for these differences included variability in operating conditions, type of print jobs, staff involvement, and application method.

The cost factors considered in this analysis were the cost of labor, the cost of the blanket wash, and the cost of the wipes. Among these three factors, the driving factor was the cost of labor, which, on average, contributed 63% of the overall cost of washing the blanket. The time spent to clean the blanket was recorded in the performance demonstrations by the observer on the first day of the demonstration for each product on the first few uses of the substitute. With continued use, the time necessary to clean the blanket may be reduced because of the press operator's familiarity with the substitute product. The wipes contributed, on average, 21% and the blanket wash, on average, 16% of the cost. There were some instances were the cost of the blanket wash was the largest contributor, but there were no instances where consistently the cost of a particular product outweighed the cost of labor or where this trend was seen for a particular facility.

Comparisons of each alternative blanket wash product with the baseline blanket wash, VM&P Naphtha (Blanket Wash 28), for each facility are summarized in the paragraphs below and in more detail in the tables which follow. Absolute and relative cost variations are reported for each alternative. An increase in the time required to clean the blanket, quantity of wash solution used, number of wipes expended, and costs of labor and materials is preceded by a plus sign; conversely, decreases are denoted by a minus sign.

Substitute Blanket Wash 1

The results of the performance demonstration indicate an increased financial cost when using Blanket Wash 1 instead of the baseline product at both facilities 3 and 6. Press operators commented that cleaning and drying times were excessive, as reflected in the performance data; performance results indicate a 25 percent increase and a 70 percent increase in cleaning times at facilities 3 and 6, respectively. The costs associated with product use (i.e., volume x price) are also significantly higher for Blanket Wash 1 when compared to the baseline, driven primarily by the product's high price. The manufacturer's price for product 1 is $20/gallon versus $5.88/gallon for the baseline product. Costs associated with product use increased roughly 220 percent and 160 percent for facilities 3 and 6, respectively. Facility 6 did not use alternative product 1 for the full week-long demonstration, discontinuing use after experiencing print quality problems believed to have been attributable to use of the alternative product.

Substitute Blanket Wash 6

The results of the performance demonstration indicate an increased financial cost when using Blanket Wash 6 instead of the baseline. Costs for facilities 11 and 15 increased roughly 20 percent and 50 percent respectively when using Blanket Wash 6 instead of the baseline. Operators at both facilities commented that the alternative required more time to be absorbed into the press wipe, causing delays in the wash-up procedure. Performance results indicate an 11 percent increase and a 69 percent increase in cleaning times at facilities 11 and 15, respectively. Press operators at both facilities commented that Blanket Wash 6 cut well. Despite a 30 percent decrease in the average quantity of blanket wash used, facility 15 experienced a 60 percent increase in costs associated with blanket wash use (i.e., volume x price) due to a product cost of more than twice the baseline cost ($12.35/gallon for product 6 compared to $5.88/gallon for the baseline product). Facility 11 experienced a 20 percent increase in product use, with a subsequent increase of 170 percent in costs associated with product use.

Substitute Blanket Wash 9

Blanket washing costs increase significantly when using Blanket Wash 9 as compared to the baseline product at facilities 10 and 15. Both facilities rated the performance of product 9 as poor, indicating that its use requires excess time and effort. Costs increased 129 percent and 84 percent at facilities 10 and 15, respectively, when compared to the baseline. Performance data indicate that increased cleaning times are the driving force behind the cost increases experienced by both facilities. Cleaning times increase 175 percent and 129 percent when compared to the baseline at facilities 10 and 15, respectively. Facility 10 discontinued use of the alternative product 9 after four washes due to its poor performance.

Substitute Blanket Wash 10

Performance data indicate mixed results in the performance of Blanket Wash 10. Blanket washing costs increased 4 percent at facility 3 and 160 percent at facility 4 when Blanket Wash 10 is used rather than the baseline. Although the performance data indicate a small increase in cost at facility 3, the press operator's comments describe difficulty in getting the blanket wash to absorb into the application shop towel. The press operator at facility 4 had similar difficulties. After washing four blankets, the press operators at both facilities 3 and 4 discontinued use of the product.

Substitute Blanket Wash 11

The results of the performance demonstration indicate an increased financial cost when using Blanket Wash 11 instead of the baseline. Overall costs per wash at facilities 1 and 2 increased roughly 120 percent and 30 percent, respectively, when using Blanket Wash 11 instead of the baseline. Costs associated with product use (i.e., volume x price) are driven by the higher

price of Blanket Wash 11 as compared to the baseline. Blanket Wash 11 is priced at $12.15/gallon compared to $5.88/gallon for the baseline product. Both press operators indicate that a dry shop towel was required to clear the oily residue left by Blanket Wash 11. Material costs (i.e., press wipes) increased by roughly 210 percent and 140 percent at facility 1 and 2, respectively. Press operators at both facilities indicated that Blanket Wash 11 cut the ink well in the case of light or medium ink coverage but was not effective when ink coverage was heavy.

Substitute Blanket Wash 12

The results of the performance demonstration indicate an increased financial cost when using Blanket Wash 12 instead of the baseline. Average costs per wash increased roughly 20 percent and 5 percent at facilities 12 and 13, respectively. Facility 12 experienced difficulty with Blanket Wash 12 in cutting through paper residue and discontinued use of the wash on paper residue coated blankets. Facility 13 experimented with a variety of dilution ratios and found that the undiluted product worked best, outperforming both the baseline as well as their standard wash. At a cost of $16.40/gallon, however, Blanket Wash 12 would not be economically competitive with the baseline ($5.88/gallon) unless the average quantity used was significantly lower.

Substitute Blanket Wash 14

The results of the performance demonstration indicate an increased financial cost when using Blanket Wash 14 instead of the baseline product at both facilities 6 and 16. Compared to the baseline, total costs per wash increased 133 percent at facility 6 and 24 percent at facility 16. The average cleaning time increased significantly at facility 6 compared to the baseline, requiring an additional minute per wash. Despite a decrease in the average cleaning time, overall costs per wash at facility 16 increase, driven primarily by the product's higher price. Blanket Wash 14 is priced at $9.55/gallon compared to $5.88/gallon for the baseline. The press operator at facility 6 commented that Blanket Wash 14 cut the ink well, however, the press operator at facility 16 commented that Blanket Wash 14 did not cut ink as well as the baseline.

Substitute Blanket Wash 19

The results of the performance data indicate an increased financial cost when using Blanket Wash 19 instead of the baseline at both facilities 18 and 19. Overall costs per wash increased roughly 170 percent and 70 percent at facilities 18 and 19, respectively. Press operators commented that cleaning and drying times were excessive, as reflected in the performance data; performance results indicate a 150 percent increase and a 60 percent increase in cleaning times at facilities 18 and 19, respectively.

Substitute Blanket Wash 20

The results of the performance demonstration indicate an increased financial cost when using Blanket Wash 20 instead of the baseline. Average costs per wash increased roughly 60 percent and 95 percent at facilities 11 and 12, respectively. Cleaning times at facility 11 increased from an average of 60 seconds for the baseline to an average of 100 seconds for Blanket Wash 20. The press operator at facility 11 cites two primary reasons for the higher cleaning times: 1) Blanket Wash 20 left an oily residue on the blanket requiring an additional cleaning step, and 2) the product's thick consistency resulted in additional delays as the press operator waited for the wash to soak into the shop towel. After three trials, the press operator at facility 12 began to experience nausea and dizziness and discontinued use of the product. For this reason the contribution of labor to the product cost for Facility 12 is based on only one observation.

Substitute Blanket Wash 21

The results of the performance demonstration indicate an increased financial cost when using Blanket Wash 21 instead of the baseline. Costs per wash increase roughly 120 percent at facility 6 and 40 percent at facility 17 when compared to the baseline. Press operators at both test facilities comment that the alternative product left an oily residue on the blanket. Extra wiping was required to clear the blanket as reflected in the performance data --- when compared to the baseline, average cleaning times increased roughly 110 percent for facility 6 and 50 percent for facility 17. Press operators at both facilities commented that Blanket Wash 21 cut the ink well. The press operator at facility 6 discontinued use of Blanket Wash 21 after six washes because the oily residue began to affect subsequent runs.

Substitute Blanket Wash 22

Performance data indicate mixed results for Blanket Wash 22. Total costs per wash increased 89 percent for facility 13, but increased only 1 percent for facility 12. Despite a 34 percent decrease in the average quantity used, costs associated with product use (i.e., volume x price) increased 50 percent for facility 12. Blanket Wash 22 is priced at $13.15/gallon compared to a price of $5.88/gallon for the baseline product. The press operator at facility 13 commented that Blanket Wash 22 cuts the ink as well as the baseline, but its thick consistency resulted in delays during wash application and drying. Average cleaning time increased 67 percent at facility 13 compared to the baseline. The press operator at facility 12 commented that Blanket Wash 22 cut the ink well and performed better than the baseline wash.

Substitute Blanket Wash 24

The results of the performance demonstration indicate an increased financial cost when using Blanket Wash 24 instead of the baseline. Costs per wash increased roughly 50 percent at facility 16 and 110 percent at facility 17, when compared to the baseline. Press operators at both facilities commented that Blanket Wash 24 cut the ink well, however, it left an oily residue on the blanket and did not readily absorb into the press wipe. When compared to the baseline, average cleaning times increased 18 percent and 160 percent for facilities 16 and 17, respectively. Despite the fact that facility 17 used a smaller average quantity of Blanket Wash 24 compared to the baseline, the costs associated with blanket wash use (i.e., volume x price) increased due to a much higher price per gallon. The manufacturers price for product 24 is $17.85/gallon versus $5.88/gallon for the baseline product. Costs associated with product use (i.e., volume x price) increased roughly 220 percent and 160 percent for facilities 16 and 17, respectively.

Substitute Blanket Wash 26

Performance data indicate mixed results for Blanket Wash 26. Total costs per wash increased roughly 30 percent for facility 5, but decreased 6 percent at facility 15. Press operators at both facilities rated the performance of Blanket Wash 26 as good on the good-fair-poor scale for every one of its trials. Despite the fact that Blanket Wash 26 is priced higher than the baseline wash, differences in costs associated with product use (i.e., volume x price) did not contribute to the higher overall cost per wash at facility 5. Blanket Wash 26 is priced at $12.24/gallon compared to a price of $5.88/gallon for the baseline. Performance data indicate that the average quantity of blanket wash used at both facilities decreased by roughly 40 percent compared to the baseline. The savings experienced by facility 26 result from a 14 percent decrease in cleaning time compared to the baseline.

Substitute Blanket Wash 29

Using Blanket Wash 29 rather than the baseline, costs per press increased roughly 60 percent at both facilities 7 and 8. Blanket Wash 29 is priced three-times higher than the baseline, contributing significantly to the higher overall costs associated with its use. Costs associated with product use (i.e., volume x price) increase 300 percent and 230 percent at facilities 7 and 8 respectively due primarily to the products higher price. Blanket Wash 29 is priced at $18.00/gallon compared to a price of $5.88/gallon for the baseline. In addition, average cleaning times are higher for Blanket Wash 29 compared to the baseline for both facilities. Cleaning times increased 22 percent for facility 7 and 64 percent for facility 8.

Substitute Blanket Wash 30

The results of the performance demonstration indicate an increased financial cost when using Blanket Wash 30 instead of the baseline. Compared to the baseline, costs per wash increased roughly 60 percent at facility 18 and 20 percent at facility 19. Increased cleaning time was the primary contributor to the higher cost per wash for both facilities. According to the performance data, cleaning times at facility 18 increased from an average of 48 seconds for the baseline to an average of 82 seconds for Blanket Wash 30; however, this alternative was only tested under heavy ink coverage conditions and the baseline wash was observed under light and medium coverage conditions. The press operator at facility 19 commented that Blanket Wash 30 evaporated slowly; cleaning times for the alternative increased by roughly 30 percent, compared to the baseline. Press operators at both facilities commented that Blanket Wash 30 cut the ink well.

Substitute Blanket Wash 31

The results of the performance demonstration indicate an increased financial cost when using Blanket Wash 31 instead of the baseline. Compared to the baseline, costs per wash increased roughly 180 percent at facility 7 and 7 percent at facility 8. The press operator at facility 7 observed that drying times for Blanket Wash 31 were greater than the baseline; cleaning times averaged 140 seconds for Blanket Wash 31, compared to 45 seconds for the baseline product. The press operator at facility 8 experienced a decrease in cleaning time, but an increase in the quantity of blanket wash used. According to the performance data, cleaning times at facility 8 decreased by 4 percent compared to the baseline. The average quantity of blanket wash used, however, increases roughly 60 percent, off-setting the gains in labor savings. Press operators at both facilities indicated that Blanket Wash 31 cut the ink well.

Substitute Blanket Wash 32

Performance data indicate mixed results in the performance of Blanket Wash 32. Total costs per wash increased roughly 120 percent at facility 1, but decreased 20 percent at facility 5. Material costs (i.e., press wipes) contributed significantly to the higher costs per wash observed at facility 1. Costs associated with material use increased roughly 160 percent compared to the baseline. After eight blanket cleanings, facility 1 discontinued use of Blanket Wash 32 because an oily-residue remained on the blanket affecting subsequent print quality. Facility 5 reported lower cleaning times and reduced blanket wash use for Blanket Wash 32, compared to the baseline. Performance results indicate a 15 percent decrease in cleaning time and a 60 percent decrease in the quantity of blanket wash used for facility 5.

Substitute Blanket Wash 34

The results of the performance demonstration indicate an increased financial cost when using Blanket Wash 34 instead of the baseline; average costs per wash increased roughly 50

percent and 80 percent at facilities 1 and 19, respectively. Performance data indicate that costs associated with product use (i.e., volume x price) at facility 1 increased roughly 160 percent; however, the press operator at facility 1 rated the performance of Blanket Wash 34 as good on the good-fair-poor scale. This increase is completely attributable to the alternative product's higher price. Blanket Wash 34 is priced at $15/gallon compared to a price of $5.88/gallon for the baseline. The press operator at facility 19 commented that Blanket Wash 34 leaves a light residue on the blanket and does not readily soak into the press wipe. At facility 19, increased cleaning time is the single largest contributor to the higher average cost per wash of Blanket Wash 34; cleaning times averaged 67 seconds for Blanket Wash 31, compared to 41 seconds for the baseline product.

Substitute Blanket Wash 37

Performance data indicate a reduced financial cost when using Blanket Wash 37 instead of the baseline. Average costs per wash decreased roughly 13 percent and 7 percent at facilities 3 and 4, respectively. Overall costs per wash decreased due to reduced cleaning time and material use (i.e., press wipes). Compared to the baseline, cleaning times decreased roughly 20 percent at both facilities 3 and 4. After several days of usage, however, facility 4 discontinued use of Blanket Wash 37 because it caused uncoated paper to stick to the blankets.

Substitute Blanket Wash 38

Performance data indicate an increased financial cost when using Blanket Wash 38 instead of the baseline. Average costs per wash increased roughly 100 percent at facility 2 and 30 percent at facility 4. Costs associated with product use (i.e., volume x price) contributed significantly to the higher overall costs of using Blanket Wash 38. Specifically, compared to the baseline, costs associated with blanket wash use increased 400 percent at facility 2 and roughly 260 percent at facility 4 due primarily to Blanket Wash 38's high price. Blanket Wash 38 is priced at $19.00/gallon compared to $5.88/gallon for the baseline. Press operators at both facilities commented that Blanket Wash 38 left an oily-residue on the blanket with subsequent affects on print quality. Facility 2 discontinued use of the alternative after 1-1/2 days of use and facility 4 discontinued use of the product after six trials.

Substitute Blanket Wash 39

The results of the performance demonstration indicate an increased financial cost when using Blanket Wash 39 instead of the baseline. Costs at facilities 5 and 8 increased roughly 25 percent and 45 percent respectively when using Blanket Wash 39 instead of the baseline. Operators at both facilities commented that the alternative left an oily residue on the blanket, although no effect was noticed on print quality. Performance results indicated roughly a 40 percent increase in cleaning time at both facilities 5 and 8. Despite a 30 percent decrease in the average quantity of blanket wash used, the costs associated with product use (i.e., volume x price) did not vary between Blanket Wash 39 and the baseline. The manufacturer's price for product 39 is $12.35/gallon compared to $5.88/gallon for the baseline product.

Substitute Blanket Wash 40

Performance data indicate mixed results in the performance of Blanket Wash 40. Compared to the baseline, average costs increased roughly 35 percent at facility 1 but decreased 4 percent at facility 10. The higher cost experienced by facility 1 is attributable to Blanket Wash 40's higher price as well as an increase in the average number of press wipes used. The average quantity of blanket wash used by facility 1 is 2.5 ounces for both the alternative as well as the baseline; however, costs associated with blanket wash use (i.e., volume x price) increased roughly 80 percent due to Blanket Wash 40's higher price. The reduced costs experienced by facility 10 are

attributable to a reduction in the average quantity of blanket wash used. Costs associated with product use decreased roughly 30 percent for facility 10. Press operators at both facilities commented that Blanket Wash 40 cut the ink well.

Summary of Cost Analysis for Blanket Wash 1

		Facility 3				Facility 6			
Facility Characteristics									
Press size		18" x 25"				18" x 25"			
Average ink coverage		Medium-Heavy				Medium			
Dilution ratio (water:wash)		0				0			
Cost Element per Blanket Wash									
		Facility 3				**Facility 6**			
		Baseline Wash	Alternative Wash	Absolute Difference[1]	Percentage Difference[1]	Baseline Wash	Alternative Wash	Absolute Difference[1]	Percentage Difference[1]
Labor[2]	Time spent cleaning (sec.)	30 (n=1)	37.5 (n=4)	+7.5	+25	30 (n=1)	51 (n=4)	+21	+70
	Cost ($)	0.28	0.35	+0.07	+25	0.28	0.47	+0.19	+70
Blanket Wash Use[2]	Average Quantity (oz.)	1.00 (n=1)	1.04 (n=14)	+0.04	+4	1.5 (n=1)	1.14 (n=8)	-0.36	-24
	Post Dilution Cost ($)	0.05	0.16	+0.11	+220	0.07	0.18	+0.11	+157
Materials and Equipment[2]	# wipes	2.0 (n=1)	1.6 (n=14)	-0.4	-20	1.0 (n=1)	2.0 (n=8)	+1.0	+100
	Cost ($)	0.22	0.18	-0.04	-18	0.11	0.22	+0.11	+100
Totals									
Total cost/wash ($)		0.55	0.69	+0.14	+25	0.46	0.87	+0.41	+89
Total cost/press[3] ($)		2.20	2.76	+0.56	+25	1.84	3.48	+1.64	+89
Total cost/press/ shift/year[4] ($)		5,500	6,900	+1,400	+25	4,600	8,700	+4,100	+89

[1] A positive sign denotes an increase and a negative sign denotes a decrease in the time, quantity, number of wipes, or cost when using the alternative blanket cleaner instead of the base product.

[2] "n" denotes the number of observations used in calculating average time, quantity, and number of wipes.

[3] Presses are assumed to have four units; therefore, four blankets are washed each time a press is cleaned.

[4] The following assumptions were made in generating a total cost/press/shift/year: 1) Each press is washed 10 times per shift, and 2) Work is performed in 8 hour shifts, 5 days per week and 50 weeks per year.

Summary of Cost Analysis for Blanket Wash 6

		Facility 11				Facility 15			
Facility Characteristics									
Press size		19" x 26"				19" x 25"			
Average ink coverage		Medium-Heavy				Medium			
Dilution ratio (water:wash)		0				0			
Cost Element per Blanket Wash									
		Facility 11				**Facility 15**			
		Baseline Wash	Alternative Wash	Absolute Difference[1]	Percentage Difference[1]	Baseline Wash	Alternative Wash	Absolute Difference[1]	Percentage Difference[1]
Labor[2]	Time spent cleaning (sec.)	61 (n=4)	68 (n=8)	+7	+11	35 (n=2)	59 (n=4)	+24	+69
	Cost ($)	0.56	0.63	+0.07	+11	0.32	0.54	+0.22	+69
Blanket Wash Use[2]	Average Quantity (oz.)	0.73 (n=4)	0.88 (n=19)	+0.15	+21	1.5 (n=2)	1.1 (n=27)	-0.4	-27
	Post Dilution Cost ($)	0.03	0.08	+0.05	+167	0.07	0.11	+0.04	+57
Materials and Equipment[2]	# wipes	1.0 (n=4)	1.0 (n=19)	0	0	1.0 (n=2)	1.1 (n=27)	+0.1	+10
	Cost ($)	0.11	0.11	0	0	0.11	0.12	+0.01	+9
Totals									
Total cost/wash ($)		0.70	0.82	+0.12	+17	0.50	0.77	+0.27	+54
Total cost/press[3] ($)		2.80	3.28	+0.48	+17	2.00	3.08	+1.08	+54
Total cost/press/shift/year[4] ($)		7,000	8,200	+1,200	+17	5,000	7,700	+2,700	+54

[1] A positive sign denotes an increase and a negative sign denotes a decrease in the time, quantity, number of wipes, or cost when using the alternative blanket cleaner instead of the base product.

[2] "n" denotes the number of observations used in calculating average time, quantity, and number of wipes.

[3] Presses are assumed to have four units; therefore, four blankets are washed each time a press is cleaned.

[4] The following assumptions were made in generating a total cost/press/shift/year: 1) Each press is washed 10 times per shift, and 2) Work is performed in 8 hour shifts, 5 days per week and 50 weeks per year.

Summary of Cost Analysis for Blanket Wash 9

		Facility 10				Facility 15			
Facility Characteristics									
Press size		19" x 28"				19" x 25"			
Average ink coverage		Medium				Medium-Heavy			
Dilution ratio (water:wash)		0				0			
Cost Element per Blanket Wash									
		Facility 10				Facility 15			
		Baseline Wash	Alternative Wash	Absolute Difference[1]	Percentage Difference[1]	Baseline Wash	Alternative Wash	Absolute Difference[1]	Percentage Difference[1]
Labor[2]	Time spent cleaning (sec.)	60 (n=1)	165 (n=4)	+105	+175	35 (n=2)	80 (n=3)	+45	+129
	Cost ($)	0.55	1.52	+0.97	+175	0.32	0.74	+0.42	+129
Blanket Wash Use[2]	Average Quantity (oz.)	3.0 (n=1)	3.1 (n=4)	+0.1	+3	1.5 (n=2)	0.86 (n=24)	-0.64	-43
	Post Dilution Cost ($)	0.14	0.25	+0.11	+79	0.07	0.07	0	0
Materials and Equipment[2]	# wipes	2.0 (n=1)	2.8 (n=4)	+0.8	+40	1.0 (n=2)	1.0 (n=23)	0	0
	Cost ($)	0.22	0.31	+0.09	+41	0.11	0.11	0	0
Totals									
Total cost/wash ($)		0.91	2.08	+1.17	+129	0.50	0.92	+0.42	+84
Total cost/press[3] ($)		3.64	8.32	+4.68	+129	2.00	3.68	+1.68	+84
Total cost/press/shift/year[4] ($)		9,100	20,800	+11,700	+129	5,000	9,200	+4,200	+84

[1] A positive sign denotes an increase and a negative sign denotes a decrease in the time, quantity, number of wipes, or cost when using the alternative blanket cleaner instead of the base product.

[2] "n" denotes the number of observations used in calculating average time, quantity, and number of wipes.

[3] Presses are assumed to have four units; therefore, four blankets are washed each time a press is cleaned.

[4] The following assumptions were made in generating a total cost/press/shift/year: 1) Each press is washed 10 times per shift, and 2) Work is performed in 8 hour shifts, 5 days per week and 50 weeks per year.

Summary of Cost Analysis for Blanket Wash 10

		Facility 3				Facility 4			
Facility Characteristics									
Press size		18" x 25"				40" x 34"			
Average ink coverage		Medium				Medium			
Dilution ratio (water:wash)		0				0			
Cost Element per Blanket Wash									
		Facility 3				Facility 4			
		Baseline Wash	Alternative Wash	Absolute Difference[1]	Percentage Difference[1]	Baseline Wash	Alternative Wash	Absolute Difference[1]	Percentage Difference[1]
Labor[2]	Time spent cleaning (sec.)	30 (n=1)	30 (n=4)	0	0	53 (n=2)	203 (n=4)	+150	+282
	Cost ($)	0.28	0.28	0	0	0.49	1.87	+1.38	+282
Blanket Wash Use[2]	Average Quantity (oz.)	1.0 (n=1)	1.0 (n=4)	0	0	3.0 (n=2)	3.0 (n=4)	0	0
	Post Dilution Cost ($)	0.05	0.07	+0.02	+40	0.14	0.22	+0.08	+57
Materials and Equipment[2]	# wipes	2.0 (n=1)	2.0 (n=4)	0	0	2.0 (n=2)	1.0 (n=1)	-1	-50
	Cost ($)	0.22	0.22	0	0	0.22	0.11	-0.11	-50
Totals									
Total cost/wash ($)		0.55	0.57	+0.02	+4	0.85	2.20	+1.35	+159
Total cost/press[3] ($)		2.20	2.28	+0.08	+4	3.40	8.80	+5.40	+159
Total cost/press/shift/year[4] ($)		5,500	5,700	+200	+4	8,500	22,000	+13,500	+159

[1] A positive sign denotes an increase and a negative sign denotes a decrease in the time, quantity, number of wipes, or cost when using the alternative blanket cleaner instead of the base product.
[2] "n" denotes the number of observations used in calculating average time, quantity, and number of wipes.
[3] Presses are assumed to have four units; therefore, four blankets are washed each time a press is cleaned.
[4] The following assumptions were made in generating a total cost/press/shift/year: 1) Each press is washed 10 times per shift, and 2) Work is performed in 8 hour shifts, 5 days per week and 50 weeks per year.

Summary of Cost Analysis for Blanket Wash 11

		Facility 1				Facility 2			
Facility Characteristics									
Press size		40" x 28"				13" x 18"			
Average ink coverage		Medium				Medium-Heavy			
Dilution ratio (water:wash)		0				0			
Cost Element per Blanket Wash									
		Facility 1				Facility 2			
		Baseline Wash	Alternative Wash	Absolute Difference[1]	Percentage Difference[1]	Baseline Wash	Alternative Wash	Absolute Difference[1]	Percentage Difference[1]
Labor[2]	Time spent cleaning (sec.)	40 (n=2)	76 (n=7)	+36	+89	40 (n=3)	30 (n=2)	-10	-25
	Cost ($)	0.37	0.70	+0.33	+89	0.37	0.28	-0.09	-25
Blanket Wash Use[2]	Average Quantity (oz.)	2.50 (n=2)	2.61 (n=33)	+0.11	+4	1.17 (n=3)	1.44 (n=33)	+0.27	+23
	Post Dilution Cost ($)	0.11	0.25	+0.14	+127	0.05	0.14	+0.09	+180
Materials and Equipment[2]	# wipes	1.0 (n=2)	3.1 (n=33)	+2.1	+210	1.0 (n=3)	2.4 (n=33)	+1.4	+140
	Cost ($)	0.11	0.34	+0.23	+209	0.11	0.26	+0.15	+136
Totals									
Total cost/wash ($)		0.59	1.29	+0.70	+119	0.53	0.68	+0.15	+28
Total cost/press[3] ($)		2.36	5.16	+2.80	+119	2.12	2.72	+0.60	+28
Total cost/press/shift/year[4] ($)		5,900	12,900	+7,000	+119	5,300	6,800	+1,500	+28

[1] A positive sign denotes an increase and a negative sign denotes a decrease in the time, quantity, number of wipes, or cost when using the alternative blanket cleaner instead of the base product.

[2] "n" denotes the number of observations used in calculating average time, quantity, and number of wipes.

[3] Presses are assumed to have four units; therefore, four blankets are washed each time a press is cleaned.

[4] The following assumptions were made in generating a total cost/press/shift/year: 1) Each press is washed 10 times per shift, and 2) Work is performed in 8 hour shifts, 5 days per week and 50 weeks per year.

Summary of Cost Analysis for Blanket Wash 12

		Facility 12				Facility 13			
Facility Characteristics									
Press size		28" x 40"				20" x 26"			
Average ink coverage		Medium				Medium			
Dilution ratio (water:wash)		1:1				1:1			
Cost Element per Blanket Wash									
		Facility 12				**Facility 13**			
		Baseline Wash	Alternative Wash	Absolute Difference[1]	Percentage Difference[1]	Baseline Wash	Alternative Wash	Absolute Difference[1]	Percentage Difference[1]
Labor[2]	Time spent cleaning (sec.)	44 (n=6)	48 (n=5)	+4	+9	60 (n=3)	62.5 (n=4)	+2.5	+4
	Cost ($)	0.41	0.44	+0.03	+9	0.55	0.58	+0.03	+4
Blanket Wash Use[2]	Average Quantity (oz.)	4.42 (n=6)	2.54 (n=28)	-1.88	-43	2.33 (n=3)	0.86 (n=23)	-1.47	-63
	Post Dilution Cost ($)	0.20	0.32	+0.12	+60	0.11	0.11	0	0
Materials and Equipment[2]	# wipes	1.8 (n=6)	2.1 (n=27)	+0.3	+17	1.3 (n=3)	1.3 (n=23)	0	0
	Cost ($)	0.20	0.23	+0.03	+15	0.14	0.14	0	0
Totals									
Total cost/wash ($)		0.81	0.99	+0.18	+22	0.80	0.83	+0.03	+4
Total cost/press[3] ($)		3.24	3.96	+0.72	+22	3.20	3.32	+0.12	+4
Total cost/press/shift/year[4] ($)		8,100	9,900	+1,800	+22	8,000	8,300	+300	+4

[1] A positive sign denotes an increase and a negative sign denotes a decrease in the time, quantity, number of wipes, or cost when using the alternative blanket cleaner instead of the base product.

[2] "n" denotes the number of observations used in calculating average time, quantity, and number of wipes.

[3] Presses are assumed to have four units; therefore, four blankets are washed each time a press is cleaned.

[4] The following assumptions were made in generating a total cost/press/shift/year: 1) Each press is washed 10 times per shift, and 2) Work is performed in 8 hour shifts, 5 days per week and 50 weeks per year.

Summary of Cost Analysis for Blanket Wash 14

		Facility 6				Facility 16			
Facility Characteristics									
Press size		18" x 25"				20" x 26"			
Average ink coverage		Medium				Medium-Heavy			
Dilution ratio (water:wash)		0				0			
Cost Element per Blanket Wash									
		Facility 6				Facility 16			
		Baseline Wash	Alternative Wash	Absolute Difference[1]	Percentage Difference[1]	Baseline Wash	Alternative Wash	Absolute Difference[1]	Percentage Difference[1]
Labor[2]	Time spent cleaning (sec.)	30 (n=1)	90 (n=3)	+60	+200	50 (n=2)	42 (n=6)	-8	-16
	Cost ($)	0.28	0.83	+0.55	+200	0.46	0.39	-0.07	-16
Blanket Wash Use[2]	Average Quantity (oz.)	1.50 (n=1)	1.25 (n=18)	-0.25	-17	2 (n=2)	2.8 (n=40)	+0.8	+40
	Post Dilution Cost ($)	0.07	0.09	+0.02	+29	0.09	0.21	+0.12	+133
Materials and Equipment[2]	# wipes	1.0 (n=1)	1.3 (n=18)	+0.3	+30	1.0 (n=2)	2.0 (n=40)	+1.0	+100
	Cost ($)	0.11	0.15	+0.04	+36	0.11	0.22	+0.11	+100
Totals									
Total cost/wash ($)		0.46	1.07	+0.61	+133	0.66	0.82	+0.16	+24
Total cost/press[3] ($)		1.84	4.28	+2.44	+133	2.64	3.28	+0.64	+24
Total cost/press/shift/year[4] ($)		4,600	10,700	+6,100	+133	6,600	8,200	+1,600	+24

[1] A positive sign denotes an increase and a negative sign denotes a decrease in the time, quantity, number of wipes, or cost when using the alternative blanket cleaner instead of the base product.

[2] "n" denotes the number of observations used in calculating average time, quantity, and number of wipes.

[3] Presses are assumed to have four units; therefore, four blankets are washed each time a press is cleaned.

[4] The following assumptions were made in generating a total cost/press/shift/year: 1) Each press is washed 10 times per shift, and 2) Work is performed in 8 hour shifts, 5 days per week and 50 weeks per year.

Summary of Cost Analysis for Blanket Wash 19

		Facility 18				Facility 19			
Facility Characteristics									
Press size		19" x 26"				19" x 26"			
Average ink coverage		Medium-Heavy				Heavy			
Dilution ratio (water:wash)		0				0			
Cost Element per Blanket Wash									
		Facility 18				**Facility 19**			
		Baseline Wash	Alternative Wash	Absolute Difference[1]	Percentage Difference[1]	Baseline Wash	Alternative Wash	Absolute Difference[1]	Percentage Difference[1]
Labor[2]	Time spent cleaning (sec.)	48 (n=6)	118 (n=5)	+70	+146	41 (n=5)	66 (n=8)	+25	+61
	Cost ($)	0.44	1.09	+0.65	+146	0.38	0.61	+0.23	+61
Blanket Wash Use[2]	Average Quantity (oz.)	1.5 (n=6)	3.0 (n=10)	+1.5	+100	0.9 (n=5)	1.7 (n=16)	+0.8	+89
	Post Dilution Cost ($)	0.07	0.28	+0.21	+300	0.04	0.16	+0.12	+300
Materials and Equipment[2]	# wipes	1.0 (n=6)	2.6 (n=10)	+1.6	+160	1.0 (n=5)	1.1 (n=16)	+0.1	+10
	Cost ($)	0.11	0.29	+0.18	+164	0.11	0.12	+0.01	+9
Totals									
Total cost/wash ($)		0.62	1.66	+1.04	+168	0.53	0.89	+0.36	+68
Total cost/press[3] ($)		2.48	6.64	+4.16	+168	2.12	3.56	+1.44	+68
Total cost/press/shift/year[4] ($)		6,200	16,600	+10,400	+168	5,300	8,900	+3,600	+68

[1] A positive sign denotes an increase and a negative sign denotes a decrease in the time, quantity, number of wipes, or cost when using the alternative blanket cleaner instead of the base product.

[2] "n" denotes the number of observations used in calculating average time, quantity, and number of wipes.

[3] Presses are assumed to have four units; therefore, four blankets are washed each time a press is cleaned.

[4] The following assumptions were made in generating a total cost/press/shift/year: 1) Each press is washed 10 times per shift, and 2) Work is performed in 8 hour shifts, 5 days per week and 50 weeks per year.

Summary of Cost Analysis for Blanket Wash 20

		Facility 11				Facility 12			
Facility Characteristics									
Press size		19" x 26"				28" x 40"			
Average ink coverage		Medium-Heavy				Medium			
Dilution ratio (water:wash)		0				0			
Cost Element per Blanket Wash									
		Facility 11				Facility 12			
		Baseline Wash	Alternative Wash	Absolute Difference[1]	Percentage Difference[1]	Baseline Wash	Alternative Wash	Absolute Difference[1]	Percentage Difference[1]
Labor[2]	Time spent cleaning (sec.)	61 (n=4)	96 (n=7)	+35	+57	44 (n=6)	120 (n=1)	+76	+173
	Cost ($)	0.56	0.88	+0.32	+57	0.41	1.11	+0.70	+173
Blanket Wash Use[2]	Average Quantity (oz.)	0.7 (n=4)	1.3 (n=24)	+0.6	+86	4.4 (n=6)	3.0 (n=1)	-1.4	-32
	Post Dilution Cost ($)	0.03	0.11	+0.08	+267	0.20	0.25	+0.05	+25
Materials and Equipment[2]	# wipes	1.0 (n=4)	1.3 (n=24)	+0.3	+30	1.8 (n=6)	2.0 (n=1)	+0.2	+11
	Cost ($)	0.11	0.14	+0.03	+27	0.20	0.22	+0.02	+10
Totals									
Total cost/wash ($)		0.70	1.13	+0.43	+61	0.81	1.58	+0.77	+95
Total cost/press[3] ($)		2.80	4.52	+1.72	+61	3.24	6.32	+3.08	+95
Total cost/press/shift/year[4] ($)		7,000	11,300	+4,300	+61	8,100	15,800	+7,700	+95

[1] A positive sign denotes an increase and a negative sign denotes a decrease in the time, quantity, number of wipes, or cost when using the alternative blanket cleaner instead of the base product.

[2] "n" denotes the number of observations used in calculating average time, quantity, and number of wipes.

[3] Presses are assumed to have four units; therefore, four blankets are washed each time a press is cleaned.

[4] The following assumptions were made in generating a total cost/press/shift/year: 1) Each press is washed 10 times per shift, and 2) Work is performed in 8 hour shifts, 5 days per week and 50 weeks per year.

Summary of Cost Analysis for Blanket Wash 21

		Facility 6				Facility 17			
Facility Characteristics									
Press size		18" x 25"				19" x 26"			
Average ink coverage		Medium				Medium-Heavy			
Dilution ratio (water:wash)		0				0			
Cost Element per Blanket Wash									
		Facility 6				Facility 17			
		Baseline Wash	Alternative Wash	Absolute Difference[1]	Percentage Difference[1]	Baseline Wash	Alternative Wash	Absolute Difference[1]	Percentage Difference[1]
Labor[2]	Time spent cleaning (sec.)	30 (n=1)	62 (n=5)	+32	+107	25 (n=5)	38 (n=9)	+13	+52
	Cost ($)	0.28	0.57	+0.29	+107	0.23	0.35	+0.12	+52
Blanket Wash Use[2]	Average Quantity (oz.)	1.5 (n=1)	2.0 (n=6)	+0.5	+33	1.5 (n=5)	1.4 (n=34)	-0.1	-7
	Post Dilution Cost ($)	0.07	0.16	+0.09	+129	0.07	0.11	+0.04	+57
Materials and Equipment[2]	# wipes	1.0 (n=1)	2.5 (n=6)	+1.5	+150	1.0 (n=5)	1.1 (n=34)	+0.1	+10
	Cost ($)	0.11	0.28	+0.17	+155	0.11	0.12	+0.01	+9
Totals									
Total cost/wash ($)		0.46	1.01	+0.55	+120	0.41	0.58	+0.17	+41
Total cost/press[3] ($)		1.84	4.04	+2.20	+120	1.64	2.32	+0.68	+41
Total cost/press/shift/year[4] ($)		4,600	10,100	+5,500	+120	4,100	5,800	+1,700	+41

[1] A positive sign denotes an increase and a negative sign denotes a decrease in the time, quantity, number of wipes, or cost when using the alternative blanket cleaner instead of the base product.

[2] "n" denotes the number of observations used in calculating average time, quantity, and number of wipes.

[3] Presses are assumed to have four units; therefore, four blankets are washed each time a press is cleaned.

[4] The following assumptions were made in generating a total cost/press/shift/year: 1) Each press is washed 10 times per shift, and 2) Work is performed in 8 hour shifts, 5 days per week and 50 weeks per year.

Summary of Cost Analysis for Blanket Wash 22

		Facility 12				Facility 13			
Facility Characteristics									
Press size		28" x 40"				20" x 26"			
Average ink coverage		Medium-Heavy				Medium			
Dilution ratio (water:wash)		1:4				1:4			
Cost Element per Blanket Wash									
		Facility 12				**Facility 13**			
		Baseline Wash	Alternative Wash	Absolute Difference[1]	Percentage Difference[1]	Baseline Wash	Alternative Wash	Absolute Difference[1]	Percentage Difference[1]
Labor[2]	Time spent cleaning (sec.)	44 (n=6)	28 (n=4)	-16	-36	60 (n=3)	100 (n=3)	+40	+67
	Cost ($)	0.41	0.26	-0.15	-36	0.55	0.92	+0.37	+67
Blanket Wash Use[2]	Average Quantity (oz.)	4.4 (n=6)	2.9 (n=13)	-1.5	-34	2.3 (n=3)	2.7 (n=20)	+0.4	+17
	Post Dilution Cost ($)	0.20	0.30	+0.10	+50	0.11	0.28	+0.17	+155
Materials and Equipment[2]	# wipes	1.8 (n=6)	2.4 (n=12)	+0.6	+33	1.3 (n=3)	2.8 (n=20)	+1.5	+115
	Cost ($)	0.20	0.26	+0.06	+30	0.14	0.31	+0.17	+121
Totals									
Total cost/wash ($)		0.81	0.82	+0.01	+1	0.80	1.51	+0.71	+89
Total cost/press[3] ($)		3.24	3.28	+0.04	+1	3.20	6.04	+2.84	+89
Total cost/press/shift/year[4] ($)		8,100	8,200	+100	+1	8,000	15,100	+7,100	+89

[1] A positive sign denotes an increase and a negative sign denotes a decrease in the time, quantity, number of wipes, or cost when using the alternative blanket cleaner instead of the base product.

[2] "n" denotes the number of observations used in calculating average time, quantity, and number of wipes.

[3] Presses are assumed to have four units; therefore, four blankets are washed each time a press is cleaned.

[4] The following assumptions were made in generating a total cost/press/shift/year: 1) Each press is washed 10 times per shift, and 2) Work is performed in 8 hour shifts, 5 days per week and 50 weeks per year.

Summary of Cost Analysis for Blanket Wash 24

		Facility 16				Facility 17			
Facility Characteristics									
Press size		20" x 26"				19" x 26"			
Average ink coverage		Heavy				Medium-Heavy			
Dilution ratio (water:wash)		0				0			
Cost Element per Blanket Wash									
		Facility 16				Facility 17			
		Baseline Wash	Alternative Wash	Absolute Difference[1]	Percentage Difference[1]	Baseline Wash	Alternative Wash	Absolute Difference[1]	Percentage Difference[1]
Labor[2]	Time spent cleaning (sec.)	50 (n=2)	59 (n=7)	+9	+18	25 (n=5)	64 (n=4)	+39	+156
	Cost ($)	0.46	0.54	+0.08	+18	0.23	0.59	+0.36	+156
Blanket Wash Use[2]	Average Quantity (oz.)	2 (n=2)	2.06 (n=35)	+0.06	+3	1.5 (n=5)	1.3 (n=4)	-0.2	-13
	Post Dilution Cost ($)	0.09	0.29	+0.20	+222	0.07	0.18	+0.11	+157
Materials and Equipment[2]	# wipes	1 (n=2)	1.3 (n=34)	+0.3	+30	1.0 (n=5)	1.0 (n=3)	0	0
	Cost ($)	0.11	0.14	+0.03	+27	0.11	0.11	0	0
Totals									
Total cost/wash ($)		0.66	0.97	+0.31	+47	0.41	0.88	+0.47	+115
Total cost/press[3] ($)		2.64	3.88	+1.24	+47	1.64	3.52	+1.88	+115
Total cost/press/shift/year[4] ($)		6,600	9,700	+3,100	+47	4,100	8,800	+4,700	+115

[1] A positive sign denotes an increase and a negative sign denotes a decrease in the time, quantity, number of wipes, or cost when using the alternative blanket cleaner instead of the base product.

[2] "n" denotes the number of observations used in calculating average time, quantity, and number of wipes.

[3] Presses are assumed to have four units; therefore, four blankets are washed each time a press is cleaned.

[4] The following assumptions were made in generating a total cost/press/shift/year: 1) Each press is washed 10 times per shift, and 2) Work is performed in 8 hour shifts, 5 days per week and 50 weeks per year.

Summary of Cost Analysis for Blanket Wash 26

		Facility 5				Facility 15			
Facility Characteristics									
Press size		12" x 18"				19" x 25"			
Average ink coverage		Medium				Medium-Heavy			
Dilution ratio (water:wash)		0				0			
Cost Element per Blanket Wash									
		Facility 5				Facility 15			
		Baseline Wash	Alternative Wash	Absolute Difference[1]	Percentage Difference[1]	Baseline Wash	Alternative Wash	Absolute Difference[1]	Percentage Difference[1]
Labor[2]	Time spent cleaning (sec.)	30 (n=1)	60 (n=4)	+30	+100	35 (n=2)	30 (n=3)	-5	-14
	Cost ($)	0.28	0.55	+0.27	+100	0.32	0.28	-0.04	-14
Blanket Wash Use[2]	Average Quantity (oz.)	1.0 (n=1)	0.56 (n=18)	-0.44	-44	1.50 (n=2)	0.85 (n=25)	-0.65	-43
	Post Dilution Cost ($)	0.05	0.05	0	0	0.07	0.08	+0.01	+14
Materials and Equipment[2]	# wipes	2.0 (n=1)	1.2 (n=18)	-0.8	-40	1.0 (n=2)	1.0 (n=25)	0	0
	Cost ($)	0.22	0.13	-0.07	-32	0.11	0.11	0	0
Totals									
Total cost/wash ($)		0.55	0.73	+0.18	+33	0.50	0.47	-0.03	-6
Total cost/press[3] ($)		2.20	2.92	+0.72	+33	2.00	1.88	-0.12	-6
Total cost/press/shift/year[4] ($)		5,500	7,300	+1,800	+33	5,000	4,700	-300	-6

[1] A positive sign denotes an increase and a negative sign denotes a decrease in the time, quantity, number of wipes, or cost when using the alternative blanket cleaner instead of the base product.

[2] "n" denotes the number of observations used in calculating average time, quantity, and number of wipes.

[3] Presses are assumed to have four units; therefore, four blankets are washed each time a press is cleaned.

[4] The following assumptions were made in generating a total cost/press/shift/year: 1) Each press is washed 10 times per shift, and 2) Work is performed in 8 hour shifts, 5 days per week and 50 weeks per year.

Summary of Cost Analysis for Blanket Wash 29

		Facility 7				Facility 8			
Facility Characteristics									
Press size		20" x 26"				20" x 26"			
Average ink coverage		Medium				Medium			
Dilution ratio (water:wash)		0				0			
Cost Element per Blanket Wash									
		Facility 7				**Facility 8**			
		Baseline Wash	Alternative Wash	Absolute Difference[1]	Percentage Difference[1]	Baseline Wash	Alternative Wash	Absolute Difference[1]	Percentage Difference[1]
Labor[2]	Time spent cleaning (sec.)	45 (n=1)	55 (n=4)	+10	+22	45 (n=4)	74 (n=14)	+29	+64
	Cost ($)	0.41	0.51	+0.10	+22	0.41	0.68	+0.27	+64
Blanket Wash Use[2]	Average Quantity (oz.)	1.0 (n=1)	1.4 (n=8)	+0.4	+40	0.7 (n=4)	0.7 (n=50)	0	0
	Post Dilution Cost ($)	0.05	0.20	+0.15	+300	0.03	0.10	+0.07	+233
Materials and Equipment[2]	# wipes	1.0 (n=1)	2.0 (n=5)	+1.0	+100	1.0 (n=4)	1.0 (n=50)	0	0
	Cost ($)	0.11	0.22	+0.11	+100	0.11	0.11	0	0
Totals									
Total cost/wash ($)		0.57	0.93	+0.36	+63	0.55	0.89	+0.34	+62
Total cost/press[3] ($)		2.28	3.72	+1.44	+63	2.20	3.56	+1.36	+62
Total cost/press/shift/year[4] ($)		5,700	9,300	+3,600	+63	5,500	8,900	+3,400	+62

[1] A positive sign denotes an increase and a negative sign denotes a decrease in the time, quantity, number of wipes, or cost when using the alternative blanket cleaner instead of the base product.

[2] "n" denotes the number of observations used in calculating average time, quantity, and number of wipes.

[3] Presses are assumed to have four units; therefore, four blankets are washed each time a press is cleaned.

[4] The following assumptions were made in generating a total cost/press/shift/year: 1) Each press is washed 10 times per shift, and 2) Work is performed in 8 hour shifts, 5 days per week and 50 weeks per year.

Summary of Cost Analysis for Blanket Wash 30

		Facility 18				Facility 19			
Facility Characteristics									
Press size		19" x 26"				19" x 26"			
Average ink coverage		Medium				Heavy			
Dilution ratio (water:wash)		0				0			
Cost Element per Blanket Wash									
		Facility 18				Facility 19			
		Baseline Wash	Alternative Wash	Absolute Difference[1]	Percentage Difference[1]	Baseline Wash	Alternative Wash	Absolute Difference[1]	Percentage Difference[1]
Labor[2]	Time spent cleaning (sec.)	48 (n=6)	82 (n=3)	+34	+71	41 (n=5)	52 (n=6)	+11	+26
	Cost ($)	0.44	0.76	+0.32	+71	0.38	0.48	+0.10	+26
Blanket Wash Use[2]	Average Quantity (oz.)	1.53 (n=6)	2.95 (n=6)	+1.42	+93	0.88 (n=5)	0.74 (n=14)	-0.14	-16
	Post Dilution Cost ($)	0.07	0.12	+0.05	+171	0.04	0.03	-0.01	-25
Materials and Equipment[2]	# wipes	1.0 (n=6)	1.2 (n=6)	+0.2	+20	1.0 (n=5)	1.0 (n=14)	0	0
	Cost ($)	0.11	0.13	0.02	+18	0.11	0.11	0	0
Totals									
Total cost/wash ($)		0.62	1.01	+0.39	+63	0.53	0.62	+0.09	+17
Total cost/press[3] ($)		2.48	4.04	+1.56	+63	2.12	2.48	+0.36	+17
Total cost/press/shift/year[4] ($)		6,200	10,100	+3,900	+63	5,300	6,200	+900	+17

[1] A positive sign denotes an increase and a negative sign denotes a decrease in the time, quantity, number of wipes, or cost when using the alternative blanket cleaner instead of the base product.

[2] "n" denotes the number of observations used in calculating average time, quantity, and number of wipes.

[3] Presses are assumed to have four units; therefore, four blankets are washed each time a press is cleaned.

[4] The following assumptions were made in generating a total cost/press/shift/year: 1) Each press is washed 10 times per shift, and 2) Work is performed in 8 hour shifts, 5 days per week and 50 weeks per year.

Summary of Cost Analysis for Blanket Wash 31

		Facility 7				Facility 8			
Facility Characteristics									
Press size		20" x 26"				20" x 26"			
Average ink coverage		Medium				Light-Medium			
Dilution rate (water:wash)		0				0			
Cost Element per Blanket Wash									
		Facility 7				Facility 8			
		Baseline Wash	Alternative Wash	Absolute Difference[1]	Percentage Difference[1]	Baseline Wash	Alternative Wash	Absolute Difference[1]	Percentage Difference[1]
Labor[2]	Time spent cleaning (sec.)	45 (n=1)	140 (n=3)	+95	+211	45 (n=4)	43 (n=4)	-2	-4
	Cost ($)	0.41	1.29	+0.88	+21	0.41	0.40	-0.01	-4
Blanket Wash Use[2]	Average Quantity (oz.)	1.0 (n=1)	1.0 (n=3)	0	0	0.7 (n=4)	1.1 (n=65)	+0.4	+57
	Post Dilution Cost ($)	0.05	0.08	+0.03	+60	0.03	0.08	+0.05	+167
Materials and Equipment[2]	# wipes	1.0 (n=1)	2.0 (n=2)	+1.0	+100	1.0 (n=4)	1.0 (n=65)	0	0
	Cost ($)	0.11	0.22	+0.11	+100	0.11	0.11	0	0
Totals									
Total cost/wash ($)		0.57	1.59	+1.02	+179	0.55	0.59	+0.04	+7
Total cost/press[3] ($)		2.28	6.36	+4.08	+179	2.20	2.36	+0.16	+7
Total cost/press/shift/year[4] ($)		5,700	15,900	+10,200	+179	5,500	5,900	+400	+7

[1] A positive sign denotes an increase and a negative sign denotes a decrease in the time, quantity, number of wipes, or cost when using the alternative blanket cleaner instead of the base product.

[2] "n" denotes the number of observations used in calculating average time, quantity, and number of wipes.

[3] Presses are assumed to have four units; therefore, four blankets are washed each time a press is cleaned.

[4] The following assumptions were made in generating a total cost/press/shift/year: 1) Each press is washed 10 times per shift, and 2) Work is performed in 8 hour shifts, 5 days per week and 50 weeks per year.

Summary of Cost Analysis for Blanket Wash 32

		Facility 1				Facility 5			
Facility Characteristics									
Press size		40" x 28"				12" x 18"			
Average ink coverage		Medium				Medium			
Dilution rate (water:wash)		0				0			
Cost Element per Blanket Wash									
		Facility 1				Facility 5			
		Baseline Wash	Alternative Wash	Absolute Difference[1]	Percentage Difference[1]	Baseline Wash	Alternative Wash	Absolute Difference[1]	Percentage Difference[1]
Labor[2]	Time spent cleaning (sec.)	40 (n=2)	105 (n=4)	+70	+162	40 (n=3)	34 (n=4)	-6	-15
	Cost ($)	0.37	0.97	+0.6	+162	0.37	0.31	-0.06	-15
Blanket Wash Use[2]	Average Quantity (oz.)	2.5 (n=2)	2.5 (n=8)	0	0	1.17 (n=3)	0.63 (n=16)	-0.67	-57
	Post Dilution Cost ($)	0.11	0.06	-0.05	-45	0.05	0.01	-0.04	-80
Materials and Equipment[2]	# wipes	1.0 (n=2)	2.5 (n=8)	+1.5	+150	1.0 (n=3)	1.0 (n=13)	0	0
	Cost ($)	0.11	0.28	+0.17	+155	0.11	0.11	0	0
Totals									
Total cost/wash ($)		0.59	1.31	+0.72	+122	0.53	0.43	-0.10	-19
Total cost/press[3] ($)		2.36	5.24	+2.88	+122	2.12	1.72	-0.40	-19
Total cost/press/shift/year[4] ($)		5,900	13,100	+7,200	+122	5,300	4,300	-1,000	-19

[1] A positive sign denotes an increase and a negative sign denotes a decrease in the time, quantity, number of wipes, or cost when using the alternative blanket cleaner instead of the base product.

[2] "n" denotes the number of observations used in calculating average time, quantity, and number of wipes.

[3] Presses are assumed to have four units; therefore, four blankets are washed each time a press is cleaned.

[4] The following assumptions were made in generating a total cost/press/shift/year: 1) Each press is washed 10 times per shift, and 2) Work is performed in 8 hour shifts, 5 days per week and 50 weeks per year.

Summary of Cost Analysis for Blanket Wash 34

		Facility 1				Facility 19			
Facility Characteristics									
Press size		40" x 28"				19" x 26"			
Average ink coverage		Medium				Medium			
Dilution rate (water:wash)		0				0			
Cost Element per Blanket Wash									
		Facility 1				**Facility 19**			
		Baseline Wash	Alternative Wash	Absolute Difference[1]	Percentage Difference[1]	Baseline Wash	Alternative Wash	Absolute Difference[1]	Percentage Difference[1]
Labor	Time spent cleaning (sec.)[2]	40 (n=2)	40 (n=4)	0	0	41 (n=5)	67 (n=13)	+26	+63
	Cost ($)	0.37	0.37	0	0	0.38	0.62	+0.24	+63
Blanket Wash Use	Average Quantity (oz.)	2.5 (n=2)	2.5 (n=41)	0	0	0.88 (n=5)	1.23 (n=13)	+0.35	+40
	Post Dilution Cost ($)	0.11	0.29	+0.18	+164	0.04	0.14	+0.10	+250
Materials and Equipment	# wipes	1.0 (n=2)	2.1 (n=41)	+1.1	+110	1.0 (n=5)	1.8 (n=13)	+0.8	+80
	Cost ($)	0.11	0.23	+0.12	+109	0.11	0.19	+0.08	+73
Totals									
Total cost/wash ($)		0.59	0.89	+0.3	+51	0.53	0.95	+0.42	+79
Total cost/press[3] ($)		2.36	3.56	+1.20	+51	2.12	3.80	+1.68	+79
Total cost/press/shift/year[4] ($)		5,900	8,900	+3,000	+51	5,300	9,500	+4,200	+79

[1] A positive sign denotes an increase and a negative sign denotes a decrease in the time, quantity, number of wipes, or cost when using the alternative blanket cleaner instead of the base product.

[2] "n" denotes the number of observations used in calculating average time, quantity, and number of wipes.

[3] Presses are assumed to have four units; therefore, four blankets are washed each time a press is cleaned.

[4] The following assumptions were made in generating a total cost/press/shift/year: 1) Each press is washed 10 times per shift, and 2) Work is performed in 8 hour shifts, 5 days per week and 50 weeks per year.

Summary of Cost Analysis for Blanket Wash 37

		Facility 3				Facility 4			
Facility Characteristics									
Press size		18" x 25"				40" x 34"			
Average ink coverage		Medium-Heavy				Medium			
Dilution ratio (water:wash)		0				0			
Cost Element per Blanket Wash									
		Facility 3				Facility 4			
		Baseline Wash	Alternative Wash	Absolute Difference[1]	Percentage Difference[1]	Baseline Wash	Alternative Wash	Absolute Difference[1]	Percentage Difference[1]
Labor[2]	Time spent cleaning (sec.)	30 (n=1)	24 (n=5)	-6	-20	53 (n=2)	42 (n=5)	-11	-21
	Cost ($)	0.28	0.22	-0.06	-20	0.49	0.39	-0.10	-21
Blanket Wash Use[2]	Average Quantity (oz.)	1.0 (n=1)	1.16 (n=22)	+0.16	+16	3.0 (n=2)	2.14 (n=11)	-0.86	-29
	Post Dilution Cost ($)	0.05	0.13	+0.08	+160	0.14	0.25	+0.11	+79
Materials and Equipment[2]	# wipes	2.0 (n=1)	1.2 (n=22)	-0.8	-40	2.0 (n=2)	1.4 (n=8)	-0.6	-30
	Cost ($)	0.22	0.13	-0.09	-41	0.22	0.15	-0.07	-32
Totals									
Total cost/wash ($)		0.55	0.48	-0.07	-13	0.85	0.79	-0.06	-7
Total cost/press[3] ($)		2.20	1.92	-0.28	-13	3.40	3.16	-0.24	-7
Total cost/press/shift/year[4] ($)		5,500	4,800	-700	-13	8,500	7,900	-600	-7

[1] A positive sign denotes an increase and a negative sign denotes a decrease in the time, quantity, number of wipes, or cost when using the alternative blanket cleaner instead of the base product.

[2] "n" denotes the number of observations used in calculating average time, quantity, and number of wipes.

[3] Presses are assumed to have four units; therefore, four blankets are washed each time a press is cleaned.

[4] The following assumptions were made in generating a total cost/press/shift/year: 1) Each press is washed 10 times per shift, and 2) Work is performed in 8 hour shifts, 5 days per week and 50 weeks per year.

Summary of Cost Analysis for Blanket Wash 38

		Facility 2				Facility 4			
Facility Characteristics									
Press size		13" x 18"				40" x 34"			
Average ink coverage		Medium				Medium			
Dilution ratio (water:wash)		0				0			
Cost Element per Blanket Wash									
		Facility 2				Facility 4			
		Baseline Wash	Alternative Wash	Absolute Difference[1]	Percentage Difference[1]	Baseline Wash	Alternative Wash	Absolute Difference[1]	Percentage Difference[1]
Labor[2]	Time spent cleaning (sec.)	40 (n=3)	65 (n=6)	+25	+62	53 (n=2)	45 (n=4)	-8	-15
	Cost ($)	0.37	0.60	+0.23	+62	0.49	0.41	-0.08	-15
Blanket Wash Use[2]	Average Quantity (oz.)	1.17 (n=3)	1.68 (n=15)	+0.51	+44	3.0 (n=2)	3.4 (n=10)	+0.4	+13
	Post Dilution Cost ($)	0.05	0.25	+0.20	+400	0.14	0.50	+0.36	+257
Materials and Equipment[2]	# wipes	1.0 (n=3)	2.1 (n=15)	+1.1	+110	2.0 (n=2)	1.8 (n=9)	-0.2	-10
	Cost ($)	0.11	0.23	+0.12	+109	0.22	0.20	-0.02	-9
Totals									
Total cost/wash ($)		0.53	1.08	+0.55	+104	0.85	1.11	+0.26	+31
Total cost/press[3] ($)		2.12	4.32	+2.20	+104	3.40	4.44	+1.04	+31
Total cost/press/shift/year[4] ($)		5,300	10,800	+5,500	+104	8,500	11,100	+2,600	+31

[1] A positive sign denotes an increase and a negative sign denotes a decrease in the time, quantity, number of wipes, or cost when using the alternative blanket cleaner instead of the base product.

[2] "n" denotes the number of observations used in calculating average time, quantity, and number of wipes.

[3] Presses are assumed to have four units; therefore, four blankets are washed each time a press is cleaned.

[4] The following assumptions were made in generating a total cost/press/shift/year: 1) Each press is washed 10 times per shift, and 2) Work is performed in 8 hour shifts, 5 days per week and 50 weeks per year.

Summary of Cost Analysis for Blanket Wash 39

		Facility 5				Facility 8			
Facility Characteristics									
Press size		12" x 18"				20" x 26"			
Average ink coverage		Medium				Medium			
Dilution ratio (water:wash)		0				0			
Cost Element per Blanket Wash									
		Facility 5				**Facility 8**			
		Baseline Wash	Alternative Wash	Absolute Difference[1]	Percentage Difference[1]	Baseline Wash	Alternative Wash	Absolute Difference[1]	Percentage Difference[1]
Labor[2]	Time spent cleaning (sec.)	30 (n=1)	43 (n=4)	+13	+43	45 (n=4)	63 (n=4)	+18	+40
	Cost ($)	0.28	0.40	+0.12	+43	0.41	0.58	+0.17	+40
Blanket Wash Use[2]	Average Quantity (oz.)	1.0 (n=1)	0.69 (n=36)	-0.31	-31	0.70 (n=4)	1.22 (n=9)	+0.52	+74
	Post Dilution Cost ($)	0.05	0.05	0	0	0.03	0.09	+0.06	+200
Materials and Equipment[2]	# wipes	2.0 (n=1)	2.2 (n=36)	+0.2	+10	1.0 (n=4)	1.2 (n=9)	+0.2	+20
	Cost ($)	0.22	0.24	+0.02	+9	0.11	0.13	+0.02	+18
Totals									
Total cost/wash ($)		0.55	0.69	+0.14	+25	0.55	0.80	+0.25	+45
Total cost/press[3] ($)		2.20	2.76	+0.56	+25	2.20	3.20	+1.00	+45
Total cost/press/shift/year[4] ($)		5,500	6,900	+1,400	+25	5,500	8,000	+2,500	+45

[1] A positive sign denotes an increase and a negative sign denotes a decrease in the time, quantity, number of wipes, or cost when using the alternative blanket cleaner instead of the base product.

[2] "n" denotes the number of observations used in calculating average time, quantity, and number of wipes.

[3] Presses are assumed to have four units; therefore, four blankets are washed each time a press is cleaned.

[4] The following assumptions were made in generating a total cost/press/shift/year: 1) Each press is washed 10 times per shift, and 2) Work is performed in 8 hour shifts, 5 days per week and 50 weeks per year.

Summary of Cost Analysis for Blanket Wash 40

		Facility 1				Facility 10			
Facility Characteristics									
Press size		40" x 28"				19" x 28"			
Average ink coverage		Light-Medium				Medium			
Dilution ratio (water:wash)		0				0			
Cost Element per Blanket Wash									
		Facility 1				Facility 10			
		Baseline Wash	Alternative Wash	Absolute Difference[1]	Percentage Difference[1]	Baseline Wash	Alternative Wash	Absolute Difference[1]	Percentage Difference[1]
Labor[2]	Time spent cleaning (sec.)	40 (n=2)	40 (n=4)	0	0	60 (n=1)	60 (n=5)	0	0
	Cost ($)	0.37	0.37	0	0	0.55	0.55	0	0
Blanket Wash Use[2]	Average Quantity (oz.)	2.5 (n=2)	2.5 (n=10)	0	0	3.0 (n=1)	1.2 (n=11)	-1.8	-60
	Post Dilution Cost ($)	0.11	0.20	+0.09	+82	0.14	0.10	-0.04	-29
Materials and Equipment[2]	# wipes	1.0 (n=2)	2.0 (n=10)	+1.0	+100	2.0 (n=1)	2.0 (n=10)	0	0
	Cost ($)	0.11	0.22	+0.11	+100	0.22	0.22	0	0
Totals									
Total cost/wash ($)		0.59	0.79	+0.20	+34	0.91	0.87	-0.04	-4
Total cost/press[3] ($)		2.36	3.16	+0.80	+34	3.64	3.48	-0.16	-4
Total cost/press/shift/year[4] ($)		5,900	7,900	+2,000	+34	9,100	8,700	-400	-4

[1] A positive sign denotes an increase and a negative sign denotes a decrease in the time, quantity, number of wipes, or cost when using the alternative blanket cleaner instead of the base product.

[2] "n" denotes the number of observations used in calculating average time, quantity, and number of wipes.

[3] Presses are assumed to have four units; therefore, four blankets are washed each time a press is cleaned.

[4] The following assumptions were made in generating a total cost/press/shift/year: 1) Each press is washed 10 times per shift, and 2) Work is performed in 8 hour shifts, 5 days per week and 50 weeks per year.

4.3 INTERNATIONAL TRADE ISSUES

Historically, foreign competition within the U.S. lithographic blanket wash industry has been limited due to the dominance of domestic suppliers as well as several barriers to import, including: 1) disparities in petroleum prices favoring U.S. manufacturers; 2) transportation expenses and import duties; and 3) paperwork requirements such as Material Safety Data Sheets (MSDS) and Toxic Substances Control Act (TSCA) reporting requirements.[1] Barriers also exist for U.S. companies seeking to enter foreign markets. U.S. manufacturers will often require a local distributing partner which invariably raises the selling price of the product, further reducing their profit margins.[2]

According to industry sources, very few companies compete on an international basis within the blanket wash industry. International competition within the U.S., however, is anticipated to increase as greater emphasis is placed on low-VOC, environmentally friendly washes.[3,4] Low VOC washes, which do not rely upon the relatively inexpensive raw materials of traditional washes, allow foreign competitors to profitably export blanket wash products to the United States. Upon arrival, concentrated blanket washes are often diluted by local blending companies and shipped to market. According to industry sources, European manufacturers are major competitors in the "green" segment of the blanket wash market, with Denmark leading the conversion to environmentally preferable washes.[5,6]

4.3.1 International Trade of Petroleum-based Blanket Washes

According to industry contacts, high-VOC, petroleum-based washes are the dominant blanket wash product worldwide because of their low cost and good performance. Imports of traditional, petroleum-based blanket washes into the United States, however, have been limited. Industry contacts cite two primary reasons for the limited import of blanket washes: 1) refining capabilities in the United States are sufficient to satisfy domestic production needs and are often superior to foreign capabilities, and 2) prohibitive costs resulting from tariffs and transportation expenses reduce potential profits for imports.[7] The potential for the export of petroleum-based washes from the United States, however, is much greater.

According to industry sources, petroleum-based blanket washes are being exported from the U.S. in significantly greater quantities than are being imported. For example, Varn International is currently generating in excess of fifty-percent of their blanket wash sales from products manufactured in the United States and exported abroad. Varn does not import any cleaning solvents into the U.S. market. The main export destinations for Varn's blanket wash products include: Mexico, the Caribbean, Central and South America, Japan, Korea, and Taiwan. In addition to Varn, several other U.S. companies are exporting blanket washes to foreign markets, including: Prisco, Printex, Anchor/Lithkemko, Rycoline, and RBP Chemical. These blanket wash manufacturers are exporting their products to various destinations throughout the world. For example, Anchor/Lithkemko exports petroleum-based blanket washes to Europe, Australia, and the Far East; Prisco exports to Europe, Mexico, and Canada; RBP Chemical exports small quantities of blanket washes to Canada and the Philippines, and Printex exports to Europe, Canada, and Korea.[8,9]

The largest markets for printed materials and therefore blanket washes are the United States, Japan, and Germany; however, the fastest growing markets are located in Asia and Central and South America.[10] Recently, Varn has been focusing their foreign trade efforts on Central and South American nations as their governments continue to relax barriers to foreign trade. Significant growth is said to be occurring in these markets, although any growth can be considered significant since current levels of importation are extremely low. The Varn representative also indicated that sales to Pacific Rim nations, such as Korea and Taiwan, are holding steady or increasing because of their expanding markets for printed materials as well as

the relaxing of import restrictions.[11] Representatives of both Varn and Anchor identified difficulties in penetrating the Japanese market because of the many import restrictions as well as the strong ethic to purchase locally.[12,13] Foreign companies attempting to enter the Japanese market would require a strong relation with a local distributing partner in order to successfully enter the Japanese market.[14] According to a representative of Varn, sales to Japan are down and have been steadily decreasing over the past several years.[15]

4.3.2 International Trade of "Low VOC" Blanket Washes

Spurred by concerns regarding the release of VOCs as well as health and safety concerns associated with the use of petroleum-based blanket washes, U.S. and foreign blanket wash manufacturers have developed a range of low-VOC washes, providing an alternative to "traditional," petroleum-based washes. A wide range of low-VOC washes are currently available in the United States, several of which are manufactured or developed abroad. According to industry contacts, low-VOC washes are more likely to be imported into the U.S. market than are petroleum-based washes because of the higher valued raw materials that go into their production. Currently, low-VOC, low toxicity washes control a small portion of the total international blanket wash market. Denmark has proven to be leader in the transition to alternative blanket washes, with an estimated 30 percent of their offset-printing shops using vegetable-based washing agents.[16]

Petroleum-based washes dominate the blanket wash market worldwide; however, the European community has made a significant investment in promoting the use of "alternative" blanket washes, with special emphasis on the use of vegetable-oil technology. It is estimated that 30 percent of Danish offset-printing shops and 5-10 percent of German offset-printing shops currently employ vegetable-based washes to some degree. To further promote their use, the European parliament has allocated roughly 2 million European Currency Units (ECU) or approximately $2.7 million to train printers in the use of vegetable-based washes, and collect and disseminate information on technical, ecological, and economic aspects of the substitution of petroleum-based washes. The Subsprint project, which has full responsibility for promoting the vegetable technology, was established in 1993 and is expected to last three years.[17] According to a representative of Varn International, based in the United Kingdom, health and safety concerns have been the primary impetus behind the promotion of vegetable-oil based washes in Europe. This is in contrast to the United States, where air quality concerns have been the driving force behind the development of alternative washes.[18]

4.3.3 Joint Ventures Impacting the International Trade of Blanket Washes

In addition to the export of blanket wash products from the United States, North American companies have penetrated foreign markets through joint ventures with foreign companies. For example, Deluxe Corporation, one of the largest printers in the United States, has entered into an agreement with Coates Lorilleux S.A., a Paris-based company, to manufacture and distribute its Printwise ink system throughout Europe and beyond. The Deluxe ink is a vegetable oil-based lithographic ink that can be converted into a water-soluble form after printing is complete. Once the conversion has occurred, the water-soluble ink can be removed with a water-based blanket cleaning solution; thereby, eliminating the need for traditional cleaning solvents containing VOCs. The vegetable oil-based ink and water-based blanket wash together compose the Printwise ink "system".

Flint Ink, under exclusive agreement with Unichema International, has recently begun marketing a vegetable-oil-based press cleaner. Unichema International, based in the Netherlands, developed the product at its laboratories in the Netherlands and first introduced the wash into the European market in 1993. Recently, Flint Ink entered into an exclusive agreement with Unichema to market the product in the United States.

Conclusions

Few companies are involved in international trade in blanket washes (both petroleum based and lower-VOC washes). By and large, petroleum-based blanket wash products are dominant in both the domestic and international printing industry with relatively little importation of such products into the United States. U.S. manufacturers are currently exporting blanket wash products worldwide with growing markets in Asia and the Americas. Although petroleum-based blanket wash products dominate the blanket wash industry, low-VOC products are also a growth area in response to air quality concerns in the United States and health and safety concerns in Europe. Vegetable-oil-based products are more likely to be imported into the United States because they are competitively priced with similar U.S. made products. The markets for these products are expected to grow as a result of U.S. joint ventures with European manufacturers.

References

1. Telecon. Van Atten, Christopher, Abt Associates Inc., Cambridge, MA, with Rollins, David, Varn International, Greater Manchester, U.K. June 15, 1995.

2. Telecon. Van Atten, Christopher, Abt Associates Inc., Cambridge, MA, with Stevens, John, Anchor/Lithkemko, Zwolle, Holland. June 21, 1995.

3. Telecon. Van Atten, Christopher, Abt Associates Inc., Cambridge, MA, with Brady, Ray, Anchor/Lithkemko, Orange Park, FL. May 3, 1995.

4. Sheppard, William J. Litho Research. Fax received April 21, 1995.

5. Sheppard, William J. Litho Research. Fax received April 21, 1995.

6. Telecon. Van Atten, Christopher, Abt Associates Inc., Cambridge, MA, with Stevens, John, Anchor/Lithkemko, Zwolle, Holland. June 21, 1995.

7. Telecon. Van Atten, Christopher, Abt Associates Inc., Cambridge, MA with Vonzwehl, Paul, Varn International, Oakland, NJ. May 31, 1995.

8. Telecon. Van Atten, Christopher, Abt Associates Inc., Cambridge, MA, with Kroneman, Barry, Prisco, Newark, NJ. May 23, 1995.

9. Hoppe, Debbie. Printex Products Corporation. Memorandum to Jed Meline, U.S. EPA. November 8, 1995.

10. Telecon. Van Atten, Christopher, Abt Associates Inc., Cambridge, MA, with Stevens, John, Anchor/Lithkemko, Zwolle, Holland. June 21, 1995.

11. Telecon. Van Atten, Christopher, Abt Associates Inc., Cambridge, MA, with Vonzwehl, Paul, Varn International, Oakland, NJ. May 31, 1995.

12. Telecon. Van Atten, Christopher, Abt Associates Inc., Cambridge, MA, with Stevens, John, Anchor/Lithkemko, Zwolle, Holland. June 21, 1995.

13. Telecon. Van Atten, Christopher, Abt Associates Inc., Cambridge, MA with Vonzwehl, Paul, Varn International, Oakland, NJ. May 31, 1995.

14. Telecon. Van Atten, Christopher, Abt Associates Inc., Cambridge, MA, with Stevens, John, Anchor/Lithkemko, Zwolle, Holland. June 21, 1995.

15. Telecon. Van Atten, Christopher, Abt Associates Inc., Cambridge, MA with Vonzwehl, Paul, Varn International, Oakland, NJ. May 31, 1995.

16. Telecon. Van Atten, Christopher, Abt Associates Inc., Cambridge, MA, with Stevens, John, Anchor/Lithkemko, Zwolle, Holland. June 21, 1995.

17. Subsprint Project Newsletter. *Subsprint: Background Detail.* Kooperationsstelle, Hamburg. July 1993.

18. Telecon. Van Atten, Christopher, Abt Associates Inc., Cambridge, MA, with Rollins, David, Varn International, Greater Manchester, U.K. June 15, 1995.